Modified Corn—Will Livestock Producers Buy It?

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Livestock producers are efficient producers who use feed rations containing the lowest cost (or least-cost) nutritive additives. As a group, they have not shown a willingness to pay a premium for feed grown from specialty seed that has been modified to meet the nutritional needs of different livestock species in different regions of the country. Will these producers ever be prepared to pay the premiums required to pull identity-preserved feed grains through the pipeline?

Feed Value and Willingness to Pay

We looked at two studies conducted by Iowa State University researchers from the departments of economics, animal science, and crop science in collaboration with industry specialists.[1] The studies analyzed the potential benefits of feasible genetic improvement to the animal feed industry, and they identified the sectors of the livestock production business most likely to use modified corn.

We incorporated yield drag, the potential costs associated with identity preservation, and the likely impact of price reductions in the additives that would compete with modified grain; and we found that, on the whole, livestock producers have a low willingness to pay a premium for modified corn.

Doubling the protein content of corn is at the top of the list in feed value—see Table 1 on pages 4 and 5 and Table 2 on page 9. This modification is estimated to be worth about nine cents per bushel for each 1 percent increase in protein. However, doubling the protein

[1]"Identifying Valuable Corn Quality Traits for Livestock Feed," by Lawrence A. Johnson, Connie L. Hardy, C. Phillip Baumel, Tun-Hsiang Yu, and Jerry L. Sell. A Project of the Iowa Grain Quality Initiative Traits Task Team, November 1999.

"Impacts of Six Genetic Modifications of Corn on Feed Cost and Consumption of Traditional Feed Ingredients," by Tun-Hsiang Yu, C. Phillip Baumel, Connie L. Hardy, Lawrence A. Johnson, Marty J. McVey, and Jerry L. Sell, 1999.

Table 1. Benefits and values of corn modifications to improve feed

Modification	Benefits	Content of Normal Corn	Estimated Gross Added Value (cents/bu/unitof trait)	Gross Added Value (cents/bu)
Increase protein content	Replaces soybean meal and some amino acids in the diet	8.7% db	9.0¢/bu per percentage point of additional protein	78.3¢/bu if protein content is doubled
Increase protein digestibility	More efficient use of protein	80%[a]	1.1¢/bu[a] per percentage point of additional digestibility	11.1¢/bu if starch digestibility is increased to 100% digestible
Increase lysine content	More lysine and protein	0.3% db	3.8¢/bu per 0.1 percentage point of additional lysine	11.5¢/bu if lysine content of corn is doubled
Increase lysine only	More lysine without total protein increase	0.3% db	6.5¢/bu per percentage point of additional lysine	19.5¢/bu if lysine content of protein is doubled
Increase methionine content	More methionine and protein	0.2% db	1.8¢/bu per 0.1 percentage point of additional methionine	3.6¢/bu if methionine content of corn is doubled
Increase methionine only	More methionine	0.2% db	3.7¢/bu per 0.1 percentage point additional methionine	7.4¢/bu if methionine content of protein is doubled
Increase total sulfur-containing amino acids (TSAA) only	More methionine and cystine	0.4% db	2.1¢/bu per 0.1 percentage point additional	8.4¢/bu if TSAA content of protein is doubled
Increase total sulfur-containing amino acids (TSAA)	More methionine, cystine, and protein	0.4% db	1.5¢/bu per 0.1 percentage point of additional TSAA	6.3¢/bu if TSAA content of corn is doubled
Increase tryptophan[b]	More protein and tryptophan	0.07% db	1.8¢/bu per 0.1 percentage point of additional tryptophan	2.2¢/bu if tryptophan content of corn is doubled
Increase tryptophan only[b]	More tryptophan	0.07% db	8.2¢/bu per 0.1 percentage point of additional tryptophan	9.9¢/bu if tryptophan content of protein is doubled
Increase threonine[b]	More threonine and protein	0.35% db	0.25¢/bu per 0.1 percentage point of additional threonine	0.9¢/bu if threonine content of corn is doubled
Increase threonine only[b]	More threonine	0.35% db	0.25¢/bu per 0.1 percentage point of additional threonine	0.9¢/bu if threonine content of protein is doubled

content of corn would probably result in a yield drag and an increased cost. We estimate that high-protein corn would be economically viable only if yield drag costs were kept under $0.40 per bushel—or, if yields were increased.

The widespread use of least-cost rations in the animal feed industry ensures that genetically modified grain will compete with traditional ingredients, such as the byproducts of processing, in a market distinguished by fierce price competition. There is the possibility that any successful customized product will upset the market for the additive that would have been used in the commodity rations. For example, high-oil corn displaces animal fat, and high-lysine corn displaces synthetic lysine.

The extent to which producers of the displaced products will lower prices when faced with competition from modified corn depends on their elasticity of supply, which measures the sensitivity of quantity supplied to the feed market due to a change in price. For feed additives, this sensitivity is often quite low, because the additives are actually byproducts in the production process of another product. This suggests that the customized product will have difficulty commanding a premium price.

Other Hurdles to Customized Seed

The cost efficient production-and-transportation system for bulk commodity grain poses an additional barrier to the successful introduction of genetic improvements in corn. A system that requires storing and transporting identity-preserved feed grain will not be able to take advantage of the present commodity system's economy of scale.

The grower of a customized product will have to be compensated for taking on the additional risks of yield differences and the poor liquidity of the smaller, customized market. And, the seed companies will need to be compensated for the risks and research needed to bring customized products to market.

Beyond Increasing Yields

Increasing yields or reducing production costs for commodity corn are, at present, the most economically profitable research avenues in

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Table 1. (continued)

Modification	Benefits	Content of Normal Corn	Estimated Gross Added Value (cents/bu/unitof trait)	Gross Added Value (cents/bu)
Increase albumin protein content	More germ proteins, lysine, methionine, cystine	7% of protein	1.1¢/bu per percentage point of additional albumin	7.9¢/bu if albumin content of corn is doubled
Increase glutelin content	More protein, lysine, methionine, cystine, threonine	25% of protein	1.1¢/bu per percentage point of additional glutelin	27.3¢/bu if glutelin content of protein is doubled
Increase C-zein protein content	More protein lysine, methionine, cystine	3.3% of protein	0.9¢/bu per percentage point of additional C-zein protein	2.7¢/bu if C-zein content of corn is doubled
Enlarge germ for oil	More energy and protein, better amino acid composition	4.1% oil db	5.8¢/bu per percentage point of additional oil	23.8¢/bu if oil content is doubled
Enlarge germ for protein	More energy and protein, better amino acid composition	8.7% protein db	3.6¢/bu for each percentage point of additional protein	30.6¢/bu if protein content is doubled
Enlarge germ size	More energy and protein, better amino acid composition	11% of kernel weight db	0.2¢/bu for each percentage point of additional germ size	19.9¢/bu if germ size is doubled
Increase oil content	More energy	4.1%	3.5¢/bu per percentage point of additional oil	14.0¢/bu if oil content is doubled
Increased starch content	More energy but decreases other nutrients	71%	0.02¢/bu per percentage point of additional starch	0.1¢/bu if starch content is increased 5 percentage points
Increase starch digestibility	More energy without decreasing other nutrients	90%[c]	2.1¢/bu per percentage point of additional starch digestibility	21.5¢/bu if starch digestibility is increased to 100% digestible
Increase availability of phosphorus	More utilizable phosphorus	20% of total phosphorus is available	2.9¢/bu per 10 percentage points of additional phosphorus availability	5.8¢/bu if phosphorus availability is doubled
Increase phosphorus (total and available)	More utilizable phosphorus	0.06% of kernel weight is available phosphorus	1.9¢/bu per 0.06 percentage point of additional available phosphorus	3.8¢/bu if available phosphorus is doubled

[a] Protein digestibility was assumed to be 82 percent for swine, 84 percent for poultry, and 73 percent for beef cattle.
[b] Swine diets only.
[c] Average digestibility was assumed to be 99 percent for swine, 90 percent for poultry, and 89 percent for beef cattle.

Iowa's Agricultural Situation

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Call it election year politics, or say that the third time is a charm. Either way, instead of waiting for a last-minute dogfight, Congress wrote into the budget a supplemental income assistance package for U.S. producers. With the two previous packages, Congress took a wait-and-see attitude, and did not pass the legislation until the fall of each year. This year, Congress opted to take a more preemptive approach as producers face another year of low commodity prices. (See the related article, "Five-Year Outlook for Iowa Agriculture," on page 8.) The package earmarks $7.1 billion in assistance to be disbursed before the end of the fiscal year, September 30. It contains $5.5 billion in direct assistance that most policy watchers agree will come in the form of an addition market transition payment. The remaining $1.64 billion is put aside for program and specialty crops. Expect disbursements to be similar to the oilseed portion of last year's package.

The grain markets around the state have started to push corn above the $2.00 per bushel level. The U.S. Department of Agriculture's (USDA) market news quoted closing corn prices around the state for April 24 ranging from $1.91 to $2.15 per bushel. It has been 19 months since the monthly average has been above $2.00 per bushel (see graphs and table).There were no significant changes in this month's USDA supply and demand estimates (see table), so the major market factor is the current dry conditions affecting much of the western Cornbelt. The dryness has allowed producers to get in the field early this year. The planters are starting to roll across the Cornbelt, and the April 24 Crop Progress report indicated 10 percent of Iowa's corn was in the ground, well above the five-year average of 3 percent.

The oilseed markets have been gaining some ground lately. Statewide reporting districts reported local elevator bids closed April 24 above the $5.00 per bushel level. North Central Iowa elevator bids were between $5.03 and $5.08 per bushel. Like with corn, beans have met strong resistance at the $5.00 level, it has been 13 months since the monthly average has been above $5.00 per bushel. Weather will continue to play an important roll in short-term price outlooks for oilseeds. Strong exports of raw beans have been supportive to the market, and this has come mainly from increased needs from China. Current Chinese policy favors the importation of the raw commodity, which allows local processors to add value through crushing. As we move through the next few months, it will become harder for old crop U.S. beans to find a market, as

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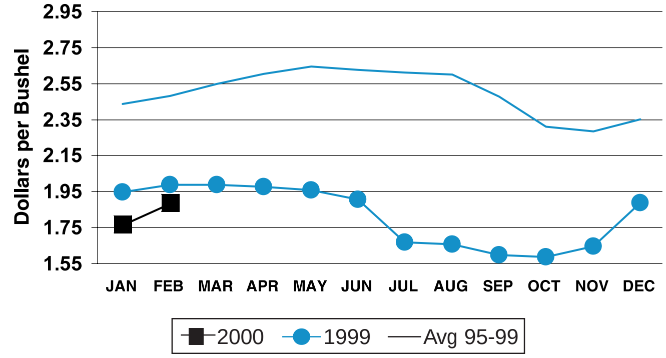
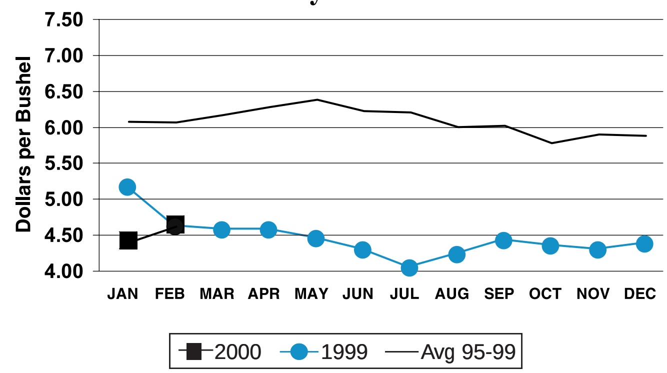
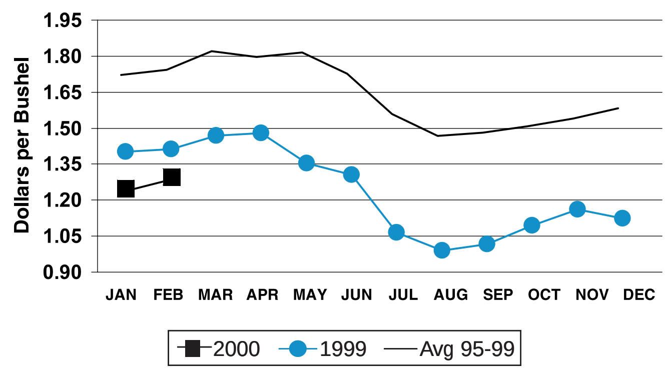
Iowa Corn Price



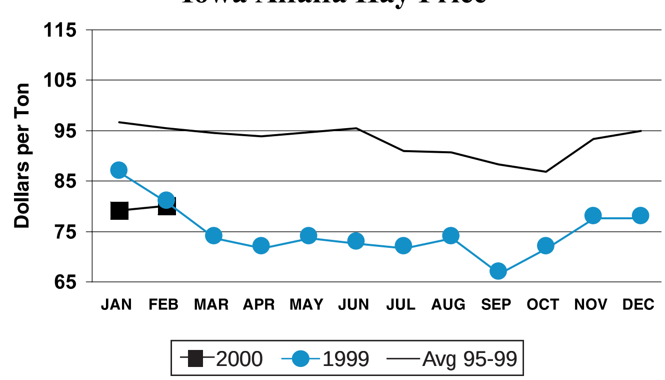
Iowa Soybean Price



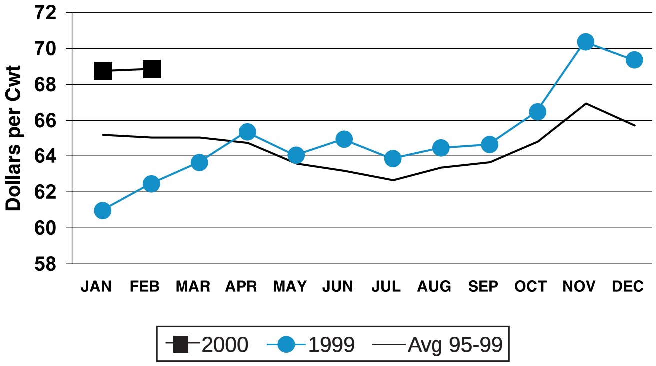
Iowa Oat Price



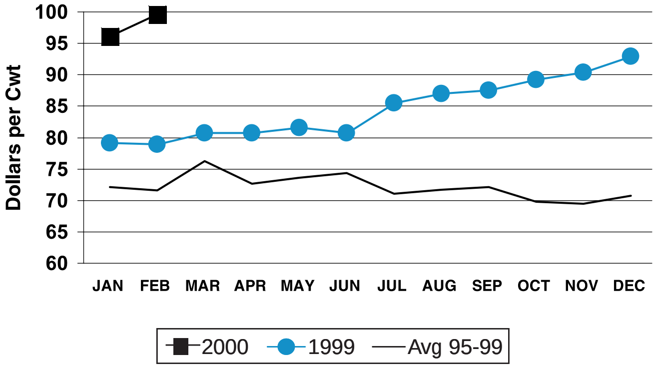
Iowa Alfalfa Hay Price



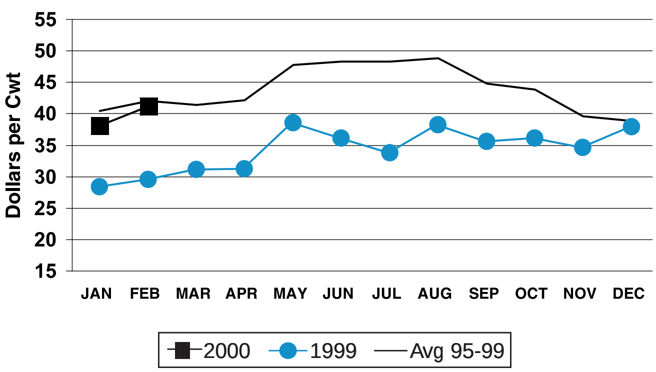
Iowa Steer and Heifer Price



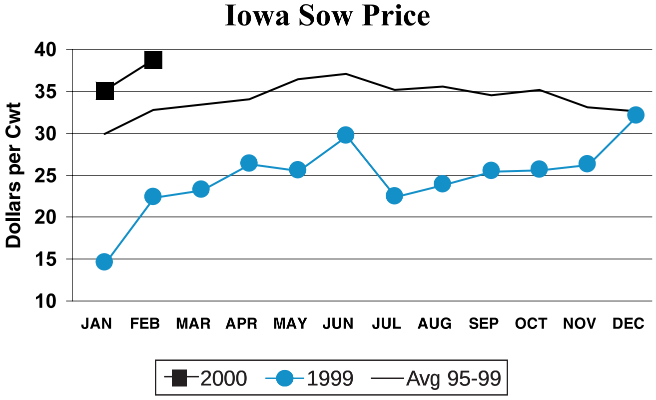
Iowa Feeder Calf Price



Iowa Barrow and Gilt Price



Iowa Sow Price



Iowa Cash Receipts Jan. – Dec. 1999

	1999	1998	1997
		(Million Dollars)	
Crops	5,010	6,356	7,311
Livestock	4,831	4,778	5,530
Total	9,841	11,134	12,841

World Stocks-to-Use Ratios

	Crop Year (April Projection) 1999/00	(Estimate) 1998/99	1997/98
		(Percent)	
Corn	18.04	18.76	14.95
Soybeans	13.00	15.39	14.56
Wheat	21.07	22.95	23.67

Average Farm Prices Received by Iowa Farmers

	February* 2000	January 2000	February 1999
		($/Bushel)	
Corn	1.88	1.76	1.98
Soybeans	4.65	4.43	4.61
Oats	1.30	1.25	1.42
		($/Ton)	
Alfalfa	80.00	79.00	81.00
All Hay	79.00	77.00	80.00
		($/Cwt.)	
Steers & Heifers	68.90	68.80	62.50
Feeder Calves	100.00	96.50	79.30
Cows	39.70	37.90	36.20
Barrows & Gilts	41.50	38.50	29.90
Sows	39.10	35.50	22.80
Sheep†	36.40	35.60	27.10
Lambs†	68.20	67.50	60.10
		($/Lb.)	
Turkeys	0.37	0.35	0.37
		($/Dozen)	
Eggs	0.49	0.32	0.37
		($/Cwt.)	
All Milk	11.40	11.10	13.70

*Mid-month †Estimate

Five-Year Outlook for Iowa Agriculture

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Crop and livestock producers in the United States are facing another challenging year. Prices for corn and soybeans have been hovering at or below cost-of-production levels for more than a year, and large global supplies and a strong U.S. dollar have led to weak export demand, hampering price recovery.

After trimming breeding herd numbers, pork producers are finally able to breathe a sigh of relief as prices for barrows and gilts have risen above break-even levels. Cattle producers continued to reduce inventory numbers and keep feeders busy by placing record numbers of cattle on feed. Cattle prices in 1999 demonstrated real strength, fueled by increased beef demand, the first such increase in 20 years. Congress helped stabilize the farming sector in 1999 with a record $8.7 billion income assistance package. These recent trends and developments cause industry professionals, analysts, and policymakers to speculate where agriculture is headed.

Against this backdrop, in January 2000, the Food and Agricultural Policy Research Institute (FAPRI) established its annual baseline projections for crop and livestock commodities produced in the United States and around the globe. An updated outlook for Iowa agriculture was generated from the results of these projections. The outlook period for Iowa is from 2000/01 to 2004/05. This baseline contains policy assumptions consistent with the continuation of the 1996 Farm Bill.

Iowa and U.S. Crops

Corn: U.S. producers are projected to trim corn planting to 77.2 million acres in 2000/01, then increase gradually over the period to 80 million acres by 2004/05. Corn trend yields increase over the period causing production to increase from 9.4 billion bushels in the first year to 10.3 billion bushels by the end of the period. The season-average farm price of corn is projected to increase from $1.85 per bushel during 1999/00 to $2.25 per bushel in 2004/05, as overall world supplies remain fairly large.

Iowa corn plantings for 2000/01 are projected to dip to 12.08 million acres initially, then increase to 12.5 million acres by the end of the period. Iowa corn yields continue to be well above average U.S. yields, and corn production is projected to increase from 1.7 billion bushels in 2000/01 to 1.81 billion bushes by 2004/05. The season-average farm price for the marketing year in Iowa is projected be $1.79 per bushel during 1999/00, and increase steadily over the period to $2.18 per bushel.

Soybeans: U.S. acres planted to soybeans are projected to increase 700,000 acres in 2000/01 to 72.7 million acres, and then trend downward through the rest of the period to 71.3 million acres by 2004/05. The increased acreage in 2000/01 reflects a more favorable bean-to-corn ratio. Soybean yield follows the trend over

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the new South American crop, estimated by the USDA at 51.5 million metric tons, finds its way to export ports.

A shift in demand has been the key in the meat sector. It appears that the increased demand the markets experienced during the last quarter of 1999 has continued to be strong during the first quarter of this year. This is a true shift in demand, as consumers continue to consume more red meat at higher prices. The USDA reported fed cattle sales for the week ending April 21 at $74.00 per hundredweight on a live basis and $119.00 per hundredweight on a carcass basis. Cattle feeders have been doing an excellent job of keeping showlists current, which is especially amazing when one considers the record numbers that have been placed on feed during the last 12 months.

Beef production for the first quarter of 2000 is running above last year's record production but production is expected to dip below last year's levels as we move into the fall. The April cattle-on-feed report showed a rather large number of heavy weight placements for the previous month, which might backup the feedlots when they finish in June and July. This could add pressure to the seasonal downturn in prices this spring and summer. However, prices will firm up in the fall as production declines.

The Iowa-Southern Minnesota market closed April 25 at $50.85 per hundredweight for the average hog. Strong demand for pork products has helped trim stocks in cold storage and raise prices about $15.00 per hundredweight above year-ago levels. Low feed costs along with higher prices recently have enabled producers to start regaining some of the equity lost during 1998 and 1999. The key is the ability to maintain the increased demand in light of higher prices. The question is going to be how much consumers are willing to continue to pay and how much red meat they will eat. ◆

the period, and production increases marginally, from 2.93 billion bushels in 2000/01 to 2.99 billion bushels in 2004/05, as yield increases more than offset acreage declines. The season-average farm price of beans during 1999/00 is projected to be $4.77 per bushel, then dips to $4.24 per bushel in 2000/01 before increasing to $5.17 per bushel during the 2004/05 marketing year. Competition from South America in the export market continues to dampen any dramatic price recovery.

Iowa soybean plantings for 2000/01 are projected to increase slightly to 10.98 million acres, then decrease by the end of the period to 10.78 million acres. Iowa soybean yields continue to be above average U.S. yields, and soybean production is projected to increase slightly from 1999/00 production levels, due to a return to trend yield. Production then slowly increases from 511 million bushels in 2000/01 to 521 million bushes by 2003/04. The season-average farm price for the marketing year in Iowa is projected to be $4.70 per bushel during 1999/00, and then drop to $4.18 per bushel in 2000/01 before increasing steadily over the period to $5.10 per bushel.

Hay: Statewide hay and oat production continue to trend downward. Season-average hay prices reflect large U.S. supplies in the short run and are projected to drop to $77.48 per ton in 1999/00, then recover slowly to $82.08 per ton by the end of the period. Season-average oat prices are projected to increase to $1.19 per bushel in 2000/01 and continue to increase marginally to $1.29 per bushel by 2004/05.

Pork: Pork producers trimmed breeding herd numbers down to 6.24 million head in 1999 and are projected to slowly start to rebuild their inventories to 6.25 million head in 2000, increasing to 6.45 million head by 2004. Hog slaughter will dip from 101.6 million head in 1999 to 95.7 million head in 2001 before rebounding to 99.5 million head in 2004. U.S. pork production is projected to drop to 18.6 billion pounds in 2000 then increase to 19.4 billion pounds in 2004. The U.S. season-average farm price is projected to increase $4.21 per hundredweight to $38.21 per hundredweight in 2000, obtain its cyclical peak of $43.53 per hundredweight in 2002, and then decline to $40.58 per hundredweight by the end of the period.

Iowa's breeding herd is projected to increase slowly from 1.16 million head to 1.21 million head by 2004. Hog slaughter will fluctuate around the 28 million head a year range as Iowa's pork industry continues to bring in pigs to feed. The Iowa season-average farm price for barrows and gilts in 2000 is projected to

Modified Corn
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Table 2. Added value (cents per bushel) of six genetic modifications of corn in swine and poultry rations

	Swine		Poultry		
Modification	**Piglets 8-13 lb**	**Finishers 233-238 lb**	**Broiler**	**Tom turkeys**	**Layer**
High protein	29.4	15.6	57.4	45.0	27.1
Enlarged-germ	0.0	10.3	48.0	44.2	36.3
High starch digestibility	—	—	39.8	33.4	5.7
High methionine	—	—	7.4	4.1	5.7
High lysine	0.0	5.2	—	—	—
High available phosphorus	1.7	1.7	—	—	—

— Indicates that estimates were not calculated in these diets.

the seed corn business. Another potential avenue that may prove profitable in the longer term includes, as mentioned, doubling the protein content of corn.

With possible federal or state mandates for reducing the phosphorus and nitrogen content of animal waste on the horizon, grain with altered nitrogen and phosphorus content holds a promise for less costly compliance. As far as investment goes, research to modify corn plants might be less costly than building capital-intensive facilities to produce desired additives such as enzymes and flavor-enhanced milk substitutes. ◆

A more in-depth discussion and additional tables are contained in "What Do Livestock Feeders Want from Seed Corn Companies?" by Dermot J. Hayes and Noah Wendt, CARD Briefing Paper 00-BP 29 (April 2000). Available online at www.card.iastate.edu. ◆