What's Cropping Up?

A NEWSLETTER FOR NEW YORK FIELD CROPS & SOILS — VOLUME 14, NUMBER 3, MAY-JUNE, 2004

It takes 70 days to grow a crop of grass.
It takes 70 million years to grow a crop of coal, oil or natural gas.

ENERGY FROM GRASS

Jerry Cherney

Department of Crop & Soil Sciences

Cornell University

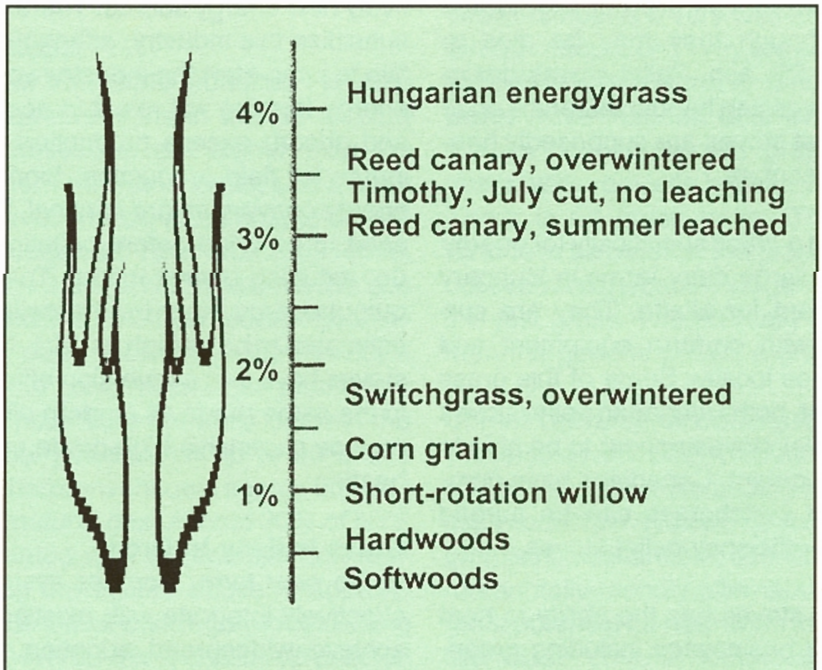
The world-wide energy crunch is not going to disappear. Sooner or later we will be forced to invest significantly in alternative fuel supplies. What features should we be looking for in an energy source? Ideally, it would have the following traits:

- Cost effective with no reliance on subsidies
- A renewable energy supply
- Easy to use and understand— low technology, small-scale
- An efficient conversion process, a high energy output:energy input ratio
- Environmentally friendly in regards to natural resource management
- A positive impact on greenhouse gas production
- Local production and consumption, stimulating rural economic development

Throughout history nothing has come close to meeting all the above traits, until now. Perennial grass has the potential to meet all of the above criteria. Grass pellet energy is a promising alternative for rural communities in the northern USA which are suffering from a decline in agricultural and forestry industries and an increasing need for affordable winter heating fuels. Pelletized grass biofuel has the potential to become a major affordable, unsubsidized fuel source capable of meeting home and small business heating requirements at less cost than all available alternatives.

Pelleted Grass as a biofuel?

Grass and straw were burned for heating and cooking by farmers on the Great Plains in past centuries. Currently, perennial grass can be pelleted and used successfully as a heating source, if the ash content is low enough. While older style wood pellet stoves will not effectively burn potential fuels like grass or grains, these new appliances have been designed specifically to burn materials with relatively high ash content while minimizing particulate emissions. It is best to discuss ash in terms of actual ash content, "high" and "low" ash terminology can be misleading. Someone selling wood pellets might refer to "high-ash" as a hard-wood with 0.75% ash or short-



Relative Ash Content of Potential Pellet Fuels rotation willow with 1% ash, relative to a soft-wood as low as 0.25% ash.

Relative ash contents of biomass are shown in the figure. Keep in mind that ash content in herbaceous plants is a product of its environment. Soil type has a very significant impact on ash content. Also, warm-season grasses, such as switchgrass, will have lower ash content than cool-season grasses. Higher water use efficiency in warm-season grasses means less silica uptake, and silica is the primary component of ash. We baled reed canarygrass in the summer of 2003, after leaving it laying out in the field for extended periods to leach out minerals, and produced bales as low as 3.2% ash. Late-cut timothy in NYS was as low as 3.4% ash directly after cutting, without any in-field leaching. Timothy tends to be low in mineral content, compared to other cool-season grasses. It may be possible to take New York State's annual crop of "hay gone bad" and either blend it with low ash pellets or burn it without any blending if the ash content is low enough.

Pellet stoves that are "bottom-feeders" (fuel is pushed up into the burn pot) are capable of handling higher ash materials, but these stoves are not considered "high-ash" stoves, although they may be able to handle materials up to 2% ash. Pellet stoves designated as "high-ash" stoves can handle materials up to 3% ash. European pellet stoves are supposedly handling even higher ash content.

Hungary has developed a grass specifically for energy purposes. Many of the large dairy farms in Hungary have pelleting equipment for alfalfa. They are currently pelleting grass with on-farm equipment and burning it in pellet stoves locally. Some of this grass exceeds 4% ash content, both Hungarian pellet stoves and Austrian Hagar pellet stoves appear to be able to deal with the high ash content. Canadians have demonstrated that pelleted switchgrass can be burned effectively in new high-efficiency pellet stoves.

The new generation of stoves has the ability to heat private homes or small businesses including greenhouses and large farm buildings. Dell-Point Technologies, Inc. produce a high ash pellet stove with an automated auger ash removal system. Grove Wood Heat, Inc. in Canada produce a pellet furnace with variable heat output from 30,000 to 150,000 BTU, approximately 5 times the output of a standard pellet stove. Bixby Energy Systems in Minnesota claims that they will have a residential central heating system based on pellet fuels available by the end of this year. The same company plans to deliver fuel pellets in bulk and remove ash with the same type of hose system used for bulk delivery of water softener pellets. There are literally dozens of companies getting into the pellet stove business, but none are developing stoves to specifically deal with ash content exceeding 3%.

There are a few hurdles to overcome to ensure that this process will be well accepted by consumers in the USA. We do not know how low the ash content of grass must be in order to effectively and conveniently burn grass. Cornell research in 2003 started the process of identifying management strategies to minimize ash content in perennial grass in New York State.

Cost-effectiveness of Pelletized Grass

Perennial grass production is an efficient use of low-cost marginal farmland for the creation of this relatively new energy source. There should be no need to subsidize this industry, although some type of incentive to jump-start the industry would be helpful. Grass energy farming will result in economic diversification and absorb excess production capacity. Fossil fuel inputs for field production, biomass processing and energy conversion are minimal. Baled grass does not need to be dried before pelleting, as wood residues do, reducing energy inputs. The ratio of total energy output:energy input for the pelleted grass system is estimated to be as high as 14:1. Newly designed pellet stoves have fuel conversion efficiencies around 85%, in the same range as modern oil furnaces. Grass can replace expensive high-grade energy forms in space heating.

Grass is Easy to Grow

In the near term, biomass systems must be able to effectively integrate with existing farming systems to achieve widespread adoption. Grower acceptance should be very high. Grass management is relatively simple and will have maximum compatibility with existing farm operations— most farmers already grow grass. Grass crops have dual use potential as an energy crop and as livestock forage. Aside from being a low potassium dry cow dairy forage, high fiber grass may be a good fiber source to complement some byproduct feeds, such as wet corn gluten feed. All equipment needed for grass management is currently available on farms. Harvest time for mature grass for pelleting is flexible to avoid peak labor periods. Grass can be overwintered in the field and harvested in the spring in an attempt to reduce the ash content, but significant yield reductions are likely.

Rural Economic Development Potential

Small scale and local production translates into rural jobs. Additionally, the use of inexpensive grass pellet fuels will allow rural residents to redirect funds they usually spend on conventional energy, and this means more money in the local economy—even more jobs. There are portable pelleting machines mounted on semi-trailers now available in Europe, allowing for on-site pelleting. On-farm non-mobile pelleting operations are also a possibility, allowing the farm community to capture the value-added component of this industry.

Environmental Benefits

It is estimated that New York State produces 1% of the total green house gas emissions in the world! New York State annual emissions are higher than the countries of Sweden or The Netherlands, and a number of other European countries. According to Governor Pataki's Green House Gas Taskforce 2003 report, agriculture will produce 0.8% of NYS green house gas emissions in 2005, and this small percentage actually is slowly decreasing each year. Agriculture is not a major contributor to the green house gas problem in NYS, but agriculture potentially can help out with the solution. Grass biofuel pellets emit up to 90% less greenhouse gasses than conventional energy sources such as oil, coal and natural gas. Almost 30% of NYS emissions are associated with commercial and residential heating. Using the figures above, if approximately 5.5% of all residential buildings (not including commercial buildings) in NYS were heated with pelleted grass or wood, this would offset 100% of all green house gas emissions caused by agriculture in NYS!

Grass biofuel also can make a positive contribution to sustainable agriculture through increasing farm diversification and increasing the land base under perennial cover. Perennial grass is ideal for nutrient management, soil conservation, maintaining open spaces, and compatible with wildlife nesting opportunities.

What about particulate emissions? This would appear to be the only negative factor in regards to burning grass. For example, whole communities out West occasionally have been forced to stop using their wood burning stoves due to excessive local particulate emissions. Grass pellet systems can address this issue in two ways. 1) new generation pellet stoves have much lower particulate emissions than older style stoves. 2) Both grass and wood ash are very alkaline, wood ash is a very effective liming source. Therefore, any particulate matter released into the atmosphere from the burning of grass should help alleviate the acid rain problem, potentially resulting in a net positive impact on the environment.

If Grass Biomass is so Great...

Grass biofuel is a very well-kept secret. Why hasn't it already caught on? Why are companies not rushing to become the first North American manufacturer with a pellet stove that can deal with >3% ash? Canadian groups have promoted grass biofuel pelleting for years, with very little impact. Grass has no champion. There is no grass lobby. There is probably not a fortune to be made in the grass futures market. It does not even have a catchy slogan. It is everywhere…., but it is just grass. What it really needs is some backing from the general public, a grass roots campaign.

Cornell University is working together with Midwestern Universities and USDA researchers to start to address and resolve the outstanding issues facing this biomass production system. Grass pellet biofuel is a very promising sustainable, economically-viable, and environmentally-friendly alternative energy source. It has great potential for near-term implementation and positive impact on rural communities.

Nutrient Management

Potassium Management for Brown Mid Rib Sorghum Sudangrass: Results of Two Years of Studies at the Mt. Pleasant Research Farm

Q.M. Ketterings[1], G. Godwin[1], J.H. Cherney[1], S. Beer[1], and T.F. Kilcer[2]
[1]Dept. of Crop & Soil Sciences, Cornell University and [2]CCE Rensselaer County

Introduction

There has been a growing interest in brown mid rib (BMR) sorghum sudangrass as a replacement for corn, often in situations where low corn yields are expected due to delayed planting because of poorly drained soils. Fertilizer trials were conducted these past couple of years to determine best management practices under New York soil and weather conditions. In this article, we report the results of a field trial on the effects of potassium (K) addition on brown mid rib sorghum sudangrass yield and forage feed quality. The trial was conducted in 2002 and 2003 on a Bath-Volusia soil at the Mt Pleasant Research farm in Tompkins County, NY. We investigated the effects of K application rate (0, 200, 400 lbs K_2O/acre split-applied in two equal applications) and nitrogen (N) application rate (0, 100, 200, 300, 400 and 500 lbs/acre split-applied in two applications) on forage yield and quality. In a previous article (Ketterings et al., 2004) we reported on the effects of N rate on yield and quality. In this article, we present and discuss the effects of K application rate.

Materials and Methods

A site description was given in Ketterings et al. (2003). Potassium was applied in the form of muriate of potash (60% K_2O). Nitrogen applications were in the form of ammonium sulfate (21% N). All plots received the equivalent of 45 lbs of P_2O_5/acre and the entire trial was replicated four times. Planting occurred on June 14, 2002, and June 9, 2003, using a John Deere grain drill and 60 lbs of seed/acre. In 2002, first and second harvest took place on July 30 and September 25, respectively. Both times, cutting height was 3-3.5 inch and harvest was initiated when the plots that received 150 lbs N/acre per cut had reached a height of 38-42 inches. In 2003, the first harvest occurred on July 31 (35 inch stand height) and the second cut on September 26 (stand height of 45 inches). All samples were analyzed for total N and K, neutral detergent fiber (NDF), and NDF digestibility (dNDF at 30 hr) at the forage laboratory of DairyOne Cooperative Inc. in Ithaca, NY. The alfalfa-grass spreadsheet of Milk2000 version 7.54 (http://www.uwex.edu/ces/forage/pubs/milk2000.xls) was used to estimate milk yields. We used standard values for neutral detergent insoluble crude protein (NDICP; 2.4% on a dry matter basis) and ether extract (3.6% on a dry matter basis) as reported for sorghum sudangrass silage in the 2001 Nutrient Requirements for Dairy Cattle (National Research Council, 2001). The 30 hour dNDF was multiplied by 1.16 to obtain an estimate of the dNDF at 48 hours (J.H. Cherney, unpublished, 2003). Soil samples (0-8 inches) were taken at planting and immediately after the first and second harvests. Samples were analyzed for pH, Morgan extractable K, nitrate and soluble salts.

Results and Discussion

Similar to results obtained in 2002, a significant NxK interaction was observed for several soil parameters and a few forage quality indicators where no or very little N had been applied. There were no NxK interactions at N levels of 100 lbs/acre per cut or greater. Because the optimum economic N application rate in this study was between 100 and 150 lbs/acre per cut and a yield decrease was seen with greater applications, we focused our study of the effects of K to plots that had received 100 or 150 lbs N/acre per cut.

Table 1: Yield, predicted milk production, crude protein, NDF, digestibility of NDF and K_2O uptake as affected by K application rates in a 2-cut brown mid rib sorghum sudangrass trial at Mt Pleasant, NY, in 2002 and 2003. All plots received 100-150 lbs N/acre per cut.

K_2O applied per cut	Yield (35% dm)	Estimated milk production		Crude protein	NDF	dNDF
lbs/acre	tons/acre	lbs/ton	lbs/acre	% of dm	% of dm	% of NDF
0	9.1 a	3153 a	10052 ab	13.2 a	61.3 b	77.2 a
100	9.7 a	3112 a	10581 a	12.8 a	61.8 ab	78.0 a
200	9.1 a	3048 a	9636 b	12.7 a	62.1 a	77.3 a

Note 1: Milk yield was predicted using Milk 2000 (http://www.uwex.edu/ces/forage/articles.htm#milk2000).
Note 2: Average values *within columns* with different letters (a,b,c) are statistically different ($\alpha = 0.05$)
Note 3: The initial soil test K was 142 lbs Morgan K/acre. N application was 100 or 150 lbs N/acre per cut.

The application of potassium did not significantly increase first or second cut dry matter yields in any of the two years (Table 1). NDF increased with K addition (2-year average) while dNDF and crude protein levels were unaffected.

The change in NDF did not significantly impact forage quality expressed as milk production per ton of silage. As expected, the K concentrations in the forage were greatly affected by K application rate (Table 2). Without K addition in the two year period, K concentrations in the forage decreased from 2.3% for the first cutting in 2002 to 1.5% for the second cut in 2003. These results support the observation that K fertilization often alters elemental concentrations in forage, but generally does not impact forage quality parameters such as CP or dNDF (Cherney et al., 2003).

Soil test potassium levels were greatly impacted by K application rate as well (Table 3). Without the addition of K, the soil went from a classification of high in the 2002 growing season to low after the first cut in 2003 and remained low at the end of the second season. Where 100 lbs K_2O/acre per cut were applied soil test K levels went from high in 2002 to medium in 2003 and with the addition of 200 lbs of K_2O/acre per cut, soil test K levels remained high. The soil supplied about 70 to 80 lbs of K_2O when no K fertilizer was applied. Harvest removed 80-130 lbs of K_2O with K fertilizer application.

Table 2: Effects of K application rates on K concentrations in BMR sorghum sudangrass and K uptake. All plots received 100-150 lbs N/acre per cut. Yields were reported in Table 1.

K_2O applied	1st cut 2002	2nd cut 2002	1st cut 2003	2nd cut 2003
lbs/acre per cut	K concentration in the forage (% of dry matter)			
0	2.3 c	2.0 b	2.1 c	1.5 b
100	2.6 b	2.3 b	2.8 b	2.1 ab
200	3.0 a	2.6 a	3.4 a	2.3 a
	K uptake (lbs K_2O/acre)			
0	79 a	73 a	73 c	74 b
100	88 a	84 a	103 b	120 a
200	94 a	90 a	128 a	108 a

Note 1: Average values *within columns* with different letters (a,b,c) are statistically different ($\alpha = 0.05$).

Conclusions

Under optimum N management, the addition of K at this site (initially high in K) did not significantly increase dry matter yields. Potassium addition did increase forage K concentrations. Soil test K levels decreased over the two years with K applications of 100 lbs K_2O/acre per cut or less. Addition of K may be needed to obtain higher yields on soils testing lower for available K or when soil test K needs to be maintained at high levels. Feed quality was not affected by K addition with the exception of a slight increase in NDF upon addition of 200 lbs of K_2O/acre per cut. Low K forage necessary for dry cows to reduce the possibility of metabolic disorders after calving was obtained without K addition. Second cuttings had lower K concentrations than first cuttings. We plan to continue this trial in 2004.

References

1. Cherney, J.H., D.J.R. Cherney, and M.D. Casler (2003). Low intensity harvest management of reed canarygrass. Agronomy Journal 95:627-634.

2. Ketterings, Q.M., T.W. Katsvairo, J.H. Cherney and T.F. Kilcer (2003). Potassium management for brown mid rib sorghum sudangrass: Results of the 2002 Mt Pleasant trial. What's Cropping Up? 13(2): 6-7.

3. Ketterings, Q.M., G. Godwin, J.H. Cherney, and T.F. Kilcer (2004). Nitrogen management for brown mid rib sorghum sudangrass: Results of two years of studies at the Mt Pleasant Research Farm. What's Cropping Up? 14(2): 5-6.

4. National Research Council (2001). Nutrient requirements of dairy cattle. 7th edition. National Research Council. National Academy Press, Washington, D.C. 408 pages.

Acknowledgments

This research was funded by a research grant from the Phosphate and Potash Institute of Canada and Townsend and Garrison Inc. Ammonium sulfate used in the trial was donated by Honeywell Inc. For further information on BMR sorghum sudangrass projects in New York contact Thomas Kilcer at the Rensselaer Cooperative Extension Office at tfk1@cornell.edu or 518-272-4210. You could also visit the BMR sorghum sudangrass website at http://nmsp.css.cornell.edu/projects/bmr.asp.

Table 3: Effects of potassium application rates soil available K levels. All plots received 100-150 lbs N/acre per cut. Yields were reported in Table 1.

K_2O applied	Soil test K Cornell Morgan Extraction					
	2002 Growing Season			2003 Growing Season		
Per cut	At planting	After 1st cut	After 2nd cut	At planting	After 1st cut	After 2nd cut
lbs/acre	---lbs K/acre---					
0	140 a	127 a	134 b	107 b	73 c	74 b
100	132 a	131 a	160 b	136 b	103 b	106 b
200	140 a	155 a	221 a	194 a	141 a	160 a

Note 1: Average values *within columns* with different letters (a,b,c) are statistically different ($\alpha = 0.05$)
Note 2: For this soil, a soil test of 45-79 lbs K/acre is classified low in K, 80-119 lbs K/acre is medium, 120-199 lbs K/acre is high and >199 lbs K/acre is classified as very high in K.

Crop Management

Soybean Seeding Rates: Not Too High and Not Too Low

Bill Cox
Dept. of Crop & Soil Sciences, Cornell University

The price of soybean seed has increased significantly in recent years and seed costs now approximate $40/acre. Coupled with the low soybean commodity prices from 1998 to 2002, many growers wondered if they could save costs by reducing soybean seeding rates. The spectacular rise in soybean commodity prices from September 2003 through April 2004 has probably lessened growers' concerns about the costs of recommended seeding rates. Nevertheless, it is important to revisit the soybean seeding rate issue because seed costs will continue to increase.

We evaluated three soybean varieties (from Pioneer, Asgrow, and Dekalb) at three row spacings (7, 15, and 30") and three seeding rates (150,000, 200,000, and 250,000 seeds/acre) in 1997 and 1998. In both years of the study, all three varieties in all three row spacings yielded best at 200,000 seeds/acre (Table 1). Based on these results and data from Guelph, Ontario in Canada, we recommend seeding rates of about 200,000 seeds/acre in New York. Table 1 also indicates that there was a 3 to 4 bu/acre yield penalty for planting soybeans at too low a rate and 1 to 2 bu/acre yield penalty for planting at too high a rate.

We planted a Pioneer variety in 7" row spacing on May 20th at the Aurora Research Farm in 2003. Aurora had a dry August (1.65") and significant aphid feeding occurred so yields were somewhat low. Nevertheless, maximum yields occurred at a seeding rate of about 200,000 seeds/acre (Table 2). In 2003, there was a 2 bu/acre yield penalty for seeding at too low a rate and a 1 bu/acre yield penalty for seeding at too high a rate.

Conclusion

Soybeans typically average only about an 80% emergence rate and in cool wet springs soybeans may only average a 70% emergence rate. We continue to recommend seeding rates of about 200,000 seeds/acre in New York, especially with May plantings, because soybeans typically respond to higher seeding rates in northern latitudes. We recommend that soybean growers carefully calibrate their soybean drill because seed size will generally be small this year so seeding rates could be higher without proper calibration. High soybean seeding rates not only increase seeding costs but also result in a slight yield penalty. If soybean growers wish to experiment with lower seeding rates, we recommend that they test in a field that they plant in late May or June when warmer soil temperatures should improve seedling emergence. Finally, we will continue this study for two more years to verify that a 200,000 seed/acre rate is still optimum for NY growing conditions.

Table 1. Soybean yields, averaged across three Roundup Ready varieties, in three row spacings and three seeding rates at the Aurora Research Farm in 1997 and 1998.

Seeding Rate seeds/acre	7"	15"	30"	Avg.
	ROW SPACING ----bu/acre----			
		1997		
150,000	37	39	37	37
200,000	42	42	40	41
250,000	40	40	37	39
Avg.	40	40	38	
LSD 0.05		2†		3‡
		1998		
150,000	45	45	42	44
200,000	48	48	45	47
250,000	47	47	44	46
Avg.	47	47	44	
LSD 0.05		2†		2‡

† LSD 0.05 compares means among row spacings.
‡ LSD 0.05 compares means among seeding rates.

Table 2. The final stand and yield of a Pioneer variety at 7" row spacing at the Aurora Research Farm in 2003.

SEEDING RATE seeds/acre	FINAL STAND plants/acre	YIELD bu/acre
150,000	118,000	37
200,000	150,000	39
250,000	193,000	39
300,000	238,000	38
350,000	269,000	38
LSD 0.05		2

Seed & Varieties

Corn that Produces Pharmaceuticals and Industrial Enzymes?? It *Is* Cropping Up!

Margaret Smith
Dept. of Plant Breeding, Cornell University

But not in New York… at least not yet. Corn plants that produce new proteins with pharmaceutical, medical, and industrial uses have been developed through genetic engineering. The techniques of genetic engineering allow researchers to extract a gene from any organism and insert it into corn. The new gene, if properly constructed and inserted, will cause the corn plant to produce a new protein that wasn't there before. This protein can then be extracted from corn grain for use in medical and industrial applications.

Up until the last few years, genetically engineered corn plants of this sort were being grown only for research and development purposes. But recently, a few medical and industrial use products have actually been produced and extracted from our old familiar friend, the corn plant! Although it is difficult to get good information on what is being produced and where (for reasons that are explained a bit later in this article), it appears that the following products are being commercially produced in and extracted from corn (http://www.agcom.purdue.edu/AgCom/Pubs/GQ/GQ_47/gqtf47.html):

1) Trypsin: Trypsin is used in manufacturing pharmaceuticals and in leather tanning and detergent industries. Sigma Chemical Company markets a version of trypsin called "TrypZean" that is produced by corn plants.

2) Aprotinin: This compound helps to control blood loss during surgery and is used in cell culture applications.

3) Avidin: When it binds to biotin, this protein can be used for medical and chemical diagnostics and it is used in protein purification.

4) Laccase: Laccase is a sort of "bio-bleach" used in detergents and is also used for adhesives in manufacturing certain types of fiberboard.

5) Brazzein: This is a natural sweetener that is low in calories but very intensely sweet (it is said to be 2,000 times sweeter than sugar).

The products listed above have been developed and commercialized by ProdiGene, a company based in Texas. Prodigene's approach is to use genetic engineering of plants, particularly corn, to provide a means to meet the growing need for protein manufacturing capacity. So they are engineering corn plants to be protein factories! Apparently these unique genetically engineered corns are being grown by a few select farmers on a few hundred acres, primarily in western Iowa and Nebraska (http://www.agcom.purdue.edu/AgCom/Pubs/GQ/GQ_47/gqtf47.html).

Prodigene is not the only company working in this arena. Others are as well, but it is not clear how many of them are commercially producing corn-based products and how many are only doing research and product development at this time. If you search in the Food and Drug Administration's database of what are called "approved events" – genetically engineered traits in particular crops that have been evaluated and approved for commercial use – you will not find any of these products. Why? Because they are being grown under permits that allow field testing but not broad-scale, unregulated environmental release. Since the number of acres to be grown of any one of these products will always be small, and since there are likely to be concerns about unregulated environmental release of corn that is not intended for food or feed use, the companies will probably never apply for "deregulated status" for these products.

There is a data base that lists all applications for field testing of genetically engineered crops where these and many other products are found. However, applying for permission to field test is rather like applying for a fishing license – the fact that you have one means you can fish, but it does not mean you must fish! So there may be many approved applications to field test products, but the products never actually get tested in the field at all, or perhaps they do get tested but turn out not to be feasible to

Seed & Varieties

Table 1. Numbers of approved and pending applications for field testing of genetically engineered corn that produces a novel protein, pharmaceutical, antibody, or industrial enzyme. (Denied or withdrawn applications are not included in these figures.)
NOTE: An approved field test permit indicates only that permission for experimental field testing has been granted, not that such testing has been done nor that commercial production is being done.

Company or University	Novel Protein Produced	Pharma-ceutical Produced	Antibody Produced	Industrial Enzyme Produced	Total
ProdiGene	57	22	2	3	84
Pioneer	16			1	17
Agracetus		1	12		13
Monsanto	9		2		11
Limagrain		4			4
Meristem Therapeutics		3			3
Iowa State Univ.	1	2			3
Dow		2			2
Garst		1			1
Horan Bros. Agri. Enterprises		1			1
Total	74	45	16	4	139

Source: Information Systems for Biotechnology web site (http://www.isb.vt.edu), Field Test Release Permits Database for the U.S. Data downloaded on 4/23/2004.

produce. This data base lists many more genetically engineered crops than are being commercially used.

Despite that limitation, it is informative to see what has been approved for field testing. A search of the database reveals that there have been 139 applications that were approved or are pending approval for field testing of corn that produces a novel protein, a pharmaceutical, an industrial enzyme, or an antibody. The types of traits engineered into the corn and the companies or universities that have applied for permission to field test them are shown in the table below.

It is clear that ProdiGene is a major player in research, development, and testing of corn that produces these novel proteins. Other companies appear to be pursuing specific areas of product development and testing (e.g., Agracetus has applied for field test permits for 12 genetically engineered events that produce antibodies in corn). However, it is difficult to know a lot about what is being developed and tested. For example, where the database lists what genes have been engineered into the corn, all but eight of the 139 approved or pending applications state, either in whole or in part, "CBI" – confidential business information – or list nothing at all! So it is hard to know what genes have actually been put into the corn, where they came from, and what new product is meant to be extracted from the corn. Finally, it is impossible to know from this data which, if any, of these products are being produced commercially.

To date, field tests have been approved in many states, but only one of the applications that is summarized in the table above lists New York. Remember that these applications give permission to field test in the states designated, but are not an obligation to do so. The one permit that lists New York is for permission to test a corn that is claimed to carry many genetically engineered traits (altered maturity, altered fertility, increased stalk strength, ear mold resistance, ability to degrade fumonisin, herbicide tolerance, insect resistance, improved animal feed quality, production of an industrial enzyme, and production of a novel protein!). To my knowledge, we haven't seen this corn tested in the state yet, and I'm quite sure we haven't seen it in commercial production! None of the other 138 genetically engineered corns summarized in the table can even be planted experimentally in New York at this time.

So what does this mean for New York corn growers? Are there concerns about these types of corn? Are there new opportunities or new markets here? First let's address concerns, and there are some. This production technology relies on identity preservation – knowing that the variety being grown, transported, and entered into the processing plant for protein extraction is really the one that carries the engineered gene needed to produce that target protein. Of course, identity preservation is not a perfect system. This means that some "normal" corn (i.e., without the engineered gene for the target protein) might slip into the protein extraction process. But of greater concern, it means that some of these special corns that were never meant to be used as food or feed could slip into the food or feed chain. The U.S. Department of Agriculture's Animal and Plant Health Inspection Service reserves the right to oversee commercial production of genetically engineered crops that produce pharmaceutical or industrial proteins, but at present it does not do so. The current system relies on a voluntary industry commitment to keep these crops out of the food and feed system, and this commitment is currently not monitored for compliance. Since these types of corn are not meant for food or feed use, no food or feed safety testing is required. Regardless of the risk or lack thereof from the novel proteins being produced, this is sure to be a cause for public concern.

Are there opportunities for New York growers? New York certainly has some areas where corn could be relatively well isolated from cross-pollination with fields that are meant for food or feed use, so in that sense New York might be a much better place to be producing these crops than Iowa or Nebraska. However, as the CEO of ProdiGene noted, this industry is in a very early stage of development and broad participation is not an option yet. Surely more new products will be genetically engineered into corn, but just as surely the regulatory environment for genetically engineered plants that produce pharmaceutical and industrial products will evolve. The bottom line in my view – stay tuned for more information as this use of biotechnology develops.

Calendar of Events

June 3, 2004	Small Grains Field Day, Aurora, NY
July 7, 2004	Weed Science Field Day, Valatie, NY
July 8, 2004	Seed Growers Field Day, Ithaca, NY
July 13, 2004	Weed Science Field Day, Aurora, NY
July 11-14, 2004	Northeastern ASA/SSSA Branch Meeting, Bordentown, NJ
July 29, 2004	Aurora Farm Field Day, Musgrave Research Farm, Aurora, NY
July 31-Aug 4, 2004	American Phytopathological Society Annual Meeting, Anaheim, CA
October 6-8, 2004	Northeastern Division APS Meeting, State College, PA
October 26, 2004	Field Crop Dealer Meeting, Comfort Suites, 7 Northside Drive, Clifton Park, NY
October 27, 2004	Field Crop Dealer Meeting, Ramada Inn, 141 New Hartford St., New Hartford, NY
October 28, 2004	Field Crop Dealer Meeting, Batavia Party House, 5762 E. Main Rd., Batavia, NY
October 29, 2004	Field Crop Dealer Meeting, Auburn Holiday Inn, 75 North St., Auburn, NY
Nov 1-4, 2004	ASA-CSSA-SSSA Annual Meeting, Seattle, WA
Nov 30-Dec 2, 2004	Northeast Region Certified Crop Advisor Conference

What's Cropping Up? is a bimonthly newsletter distributed by the Crop and Soil Sciences Department at Cornell University. The purpose of the newsletter is to provide timely information on field crop production and environmental issues as it relates to New York agriculture. Articles are regularly contributed by the following Departments at Cornell University: Crop and Soil Sciences, Plant Breeding, Plant Pathology, and Entomology. **To get on the mailing list, send your name and address to Pam Kline, 234 Emerson Hall, Cornell University, Ithaca, NY 14853.**

Cornell Cooperative Extension

Dept. of Crop and Soil Sciences
234 Emerson Hall
Cornell University
Ithaca, NY 14853

Helping You Put Knowledge to Work