

Corn Marketing Program of Michigan 2010 Research Report

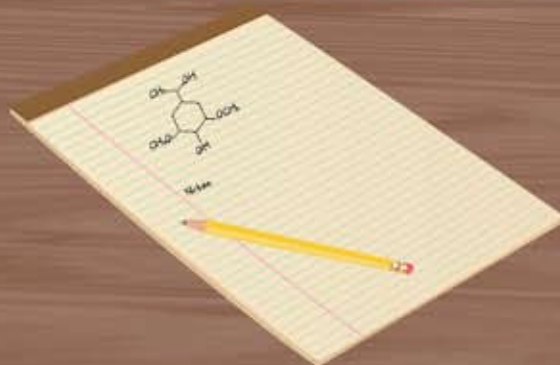


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Dear Michigan Corn Farmers:

In 1992, the Corn Marketing Program of Michigan (CMPM) was established by corn farmers in Michigan in order to enhance the economic viability of corn production in our state. Every five years, the check-off program goes back to a vote of the state's corn farmers. Since the program's establishment, farmers have overwhelmingly supported the check-off program in each continuation vote. Each year we work hard to continue to prove that the CMPM is worth your support and one of the best ways we can do this is through corn-related research.

Through the CMPM, corn farmers in Michigan have invested in check-off funded research projects that focus on improving on-farm production and conservation practices, strengthening traditional markets, and also developing new uses for corn. The CMPM strives to expand and enhance current markets while at the same time develop new markets for our state's corn.

The CMPM has funded more than 225 research projects that have led to an expanding corn heat industry and the introduction of new farming techniques and practices that enhance productivity and conservation. We have dedicated funds for the improvement of the livestock industry through corn and dried distillers grain feeding trials, odor control research, animal waste usage and more.

It is exciting to be part of such a forward looking group. Research funded through the CMPM five to ten years ago is being commercialized and can be found in the marketplace. Our funds have led to the development of a sodium-free salt substitute, pharmaceutical compounds and plastics. The CMPM is dedicated to investing funds contributed by the state's corn farmers into not only improving production practices, but also towards developing new markets for Michigan's corn crop.

The following pages in our Annual Research Report showcase how the CMPM has invested check-off funds. The research projects discussed were completed in 2008 and 2009. All of the research is designed to help keep the Michigan corn industry on the cutting edge of production, technology and new uses. If you have any questions or suggestions about the research funded through the farmer check-off funds, contact the CMPM office at 1-888-323-6601.



Sincerely,

Clark Gerstacker, President
Corn Marketing Program of Michigan

PRODUCTION AND CONSERVATION INVESTMENTS

Corn farmers take a gamble every year when they plant their crops in the spring; but when they try a new production or conservation technique as well, that risk escalates. To help minimize this risk to farmers the CMPM funds research looking at tillage practices, pest control, conservation and fertilizer recommendations. Through this check-off funded research, farmers can benefit from ground-breaking practices which are analyzed in test plots across the state, without jeopardizing their bottom line. It is through this research that advancements in production and conservation practices are made which is why the CMPM highly values agronomic research and the role it plays within the agricultural industry.

Western Bean Cutworm Poses Problem for Corn

Western bean cutworm (WBC) is native to the western plains. In the mid-1990s, it moved rapidly east into the Great Lakes region. This pest poses a major problem for corn production, often reducing yield and quality as a result of caterpillar feeding and fungal infection.

In order to help Michigan's corn farmers deal with this ever-growing issue, the CMPM conducted a study with Michigan State University (MSU) to help Michigan corn farmers know when and where to look for WBC and to determine aspects of the lifecycle of WBC. To accomplish these goals, Dr. Chris DiFonzo, principal researcher and professor of entomology at MSU, ran a large pheromone trapping network throughout Michigan, as well as infesting individual plants with WBC egg masses.

The 2009 study included milk-jug pheromone traps at 279 unique trap locations in 47 counties across Michigan and captured more than 28,000 moths. "This is an astonishing number when compared to results from previous years and surrounding states," said DiFonzo. Studies in other states and provinces showed drastically lower moth populations: Ontario (1637), Ohio (566), Pennsylvania (93), New York (11) and Quebec (8). "WBC has now spread out of western Ontario and has moved as far east as Quebec and Pennsylvania, showcasing the tremendous mobility of this pest," added DiFonzo. "Damage was limited to central Michigan and was reported on both corn and dry beans. By 2010-2011, we are predicting the damage will likely move into the thumb."

The second half of the study looked at collecting information regarding the lifecycle of WBC. Groups of plants were sacrificed to WBC and cut apart to collect information on larval number and size at 1, 5, 10, 14, 21 and 28 days after hatch. "This provided the first information about WBC egg survival, life stages and degree days in the Great Lakes Region, and proved that WBC life history does differ in Michigan compared to the western plains," said DiFonzo. "These differences have implications for scouting, thresholds and other aspects of WBC management in the Great Lakes region."

Individual pre-tassel plants were infested with a single egg mass. Masses were checked daily for hatch to establish a cohort (group) that hatched on August 1. After hatch, each egg mass was recovered and examined for egg number, percent hatch and predation. Groups of plants were then

sacrificed 1, 5, 10, 14, 21 and 28 days after hatch (DAH) and carefully dissected to record number and type of potential natural enemies, as well as number and distribution of larvae recovered. All larvae were saved and head capsule width measured to determine stage. A temperature probe recorded temperature to calculate degree days of larval development. Data in Michigan was then compared to what was reported about WBC in western states.

Figure 1 shows the location of WBC larvae on the plants. The first instar larvae were found primarily in or near the tassel, but a substantial number were found already in the silks. By 10 days after hatch, larvae had moved into the ear zone. "A significant number of larvae were found between the stalk and the ear at 14 and 21 days after hatch," DiFonzo noted. "These larvae eventually chewed into the side of the ear by 28 days after hatch." At least 500 degree days were needed to develop to the 6th instar, the larval stage that drops to the ground where it can survive Michigan's harsh winter.

Distribution of WBC on plants

	1	5	10	14	21	28
Location	DAH	DAH	DAH	DAH	DAH	DAH
tassel	38%	38%	1%	-	-	-
tassel leaf	19%	9%	-	-	-	-
leaf axils	26%	41%	19%	-	-	-
silks	17%	12%	73%	34%	-	-
betwn ear/stalk	-	-	7%	33%	33%	-
ear~tip	-	-	-	33%	67%	54%
ear~side	-	-	-	-	-	46%

Figure 1: Location of WBC larvae on the plants

"As a result of this study, Michigan's farmers are better informed regarding WBC and its lifecycle. We are now able to scout as necessary and work to limit the damage done by the pest," said Clark Gerstacker, CMPM president, National Corn Growers Association Corn Board member, and a corn grower from Midland. "We are grateful for the work Dr. DiFonzo has done regarding WBC. The results from her project will help farmers across the state protect their crop from this pest."

Thumb Ag Research & Education

Ultimately, advancements in technology and production practices improve the farmer’s bottom line. The CMPM understands the important role that agronomic research plays in these advancements. To help Michigan farmers increase their profitability, the CMPM works on behalf of the state’s corn farmers by funding an assortment of agronomic research. One such area they focus on every year is various corn variety trials.

For five years, the CMPM has partnered with the agricultural Extension educators of Huron, Sanilac and Tuscola counties to collaborate with thumb-area growers to conduct extensive corn and soybean variety field trials. “In order to ensure the profitable production of corn, on-farm research and demonstration plots need to be conducted to evaluate the value of emerging technologies, varieties and products,” said Clark Gerstacker, CMPM president and a corn farmer from Midland. “By utilizing results from on-farm plots, corn farmers across the state are able to make more informed decisions that will ultimately affect their

individual farming operations.” For the 2009 study, six corn trial sites and three soybean trial sites were conducted. In total, 126 corn hybrids and 87 soybean hybrids were evaluated. In addition, studies were conducted on population trials, nitrogen fertilizer rates, and starter fertilizer. Treatments within each trial will include six rows, planted 30 inches apart and 100 feet long and were replicated four times. Table 1 shows the corn variety trial results for the glyphosate resistant 85-94 growing day corn. Throughout the course of the 2009 trial, a variety of corn populations were studied. “The populations ranging from 28,000 to 38,000 yielded the same statistically, while populations at 24,000 to 28,000 were significantly lower,” said Dave Pratt, former TARE Project Leader. The study also looked at sidedress nitrogen rates. “The purpose of the sidedress study was to evaluate application rates in order to determine the economic optimum in order to achieve maximum yields,” said Gerstacker. Table 2 illustrates the sidedress rates used in the study and the resulting yields. “No significant difference was observed

Table 1: Glyphosate Resistant Trial 85-94 Days RM								
Variety	Maturity (days)	Traits	Seed Treatment	5 Location Averages				*Per Acre Gross \$
				Avg. bu. Ac.	Avg. Moisture	Avg. Test Wt	Avg. Lodging	
Mycogen Seeds 2J337	92	VT3/RR	Cruiser LR	208.68	20.2	55	1.67	804.90
Great Lakes Hybrids 4041G3	90	VT3	P250	204.16	20.4	55	0.67	786.28
Crow's 194-70 VT3	94	VT3	Cruiser 250	203.71	20.7	54	0.00	782.74
NuTech Seed 3C-889	89	RR/YGCB		202.84	21.3	55	1.58	775.36
Stine Seed Company 9204 VT3	91	VT3	Poncho 250	202.73	20.7	55	0.67	778.85
Monsanto DKC43-27	93	VT3	P250	201.78	19.6	52	0.42	781.62
Stewart's 4T 435	94	VT3		201.34	20.4	53	0.08	775.23
Garst Seed Co. 89K64GT/CB/LL	88	GT/CB	Cruiser 250	199.92	19.1	54	3.42	777.41
Crow's 1685	92	VT3	Cruiser	199.89	21.2	54	0.50	764.70
NuTech Seed 3T-90	90	VT3	C-250	199.80	20.8	54	2.00	766.67
Dahlco Seed Inc. 6944	94	VT3	Poncho 250	198.55	20.2	54	1.42	765.71
Hyland Seeds H9204BRC	92	VT3	P250	197.61	20.8	55	1.92	758.57
Rupp Seeds, Inc. XR 8002 VT	94	VT3	Cruiser 250	197.37	20.5	55	1.92	759.28
Hyland Seeds HLCVR54	92	VT3	P250	196.77	20.5	55	1.75	757.28
Great Lakes Hybrids 4481G3	94	VT3	P250	196.13	21.0	55	2.08	751.27
Stewart's 4T 458	95	VT3	MXDH	195.75	21.8	54	2.58	745.26
Pioneer Hi-Bred Int'l Inc. 38N88	92	HX/LL/RR	C500	194.68	20.5	55	0.33	749.11
Great Lakes Hybrids 4415G3	94	VT3	P250	193.91	20.4	55	0.17	746.57
NK Syngenta N23K-GT/CB/LL	99	GT/CB/LL	C-250	192.19	19.7	55	3.75	744.29
NK Syngenta N29A-GT/CB/LL	92	GT/CB/LL	C-250	191.02	21.3	55	2.25	730.41
Mycogen Seeds 2C302	90	HX/RR	Cruiser LR	190.50	20.6	54	2.42	732.27
NuTech Seed 3T-393	93	VT3	C-250	189.97	20.5	55	1.67	730.99
Brownseed 5B-887	87	GT/CB/LL	C-250	187.55	19.7	55	3.83	725.92
Pioneer Hi-Bred Int'l Inc. 38M60	94	HXX/LL/RR	C500	187.28	19.9	55	0.08	724.02
NK Syngenta N27B-GT/CB/LL	91	GT/CB/LL	C-250	186.32	18.9	55	2.75	726.18
Crow's 15-23	93			185.54	20.5	55	0.92	713.83
NK Syngenta N22-C2	87	GT/CB/LL	C-250	181.83	19.0	56	1.58	707.96
Dyna-Gro 53V80	92	VT3	Maxim P250	178.65	19.7	54	3.67	691.91
			Average	195.23	20.3	55	1.81	
Lodging: 0=none, 1=moderate <20%, 2=severe 20-50%, 3=very severe >50%								
Bolded yields are not significantly different from the highest yielding variety within the column.								
*Per Acre Gross - Bushels at \$4 minus cost to dry with propane at \$1.53/gal. (seed cost not included).								

between nitrogen application rates above 80 pounds/acre,” added Pratt. “However, the maximum yield of 181.2 bushels was obtained at 200 pounds of nitrogen per acre, resulting in an overall net loss of \$10.75 per acre return, with corn priced at \$3.50/bushel and nitrogen at \$0.50/pound.” The full results of the research were published in *Thumb Ag Research & Education, 2009 Field Trials*.

Sidedress N (lb N/A)	Total N (lb N/A)	Moisture (%)	Yield (bu/A)
0	23	25.1	87.4
40	63	24.4	128.4
80	103	24.5	157.5
120	143	24.4	175.7
160	183	23.5	179.4
200	223	24.5	181.2
		LSD (0.05)	34.1
		CV%	9

Table 2: Nitrogen sidedress rates

Center for Excellence Showcases New
Agronomic Practices

The CMPM has partnered with the Lenawee Conservation District, the Natural Resources Conservation Service and the Michigan Soybean Promotion Committee to conduct an extensive research and demonstration project known as the Lenawee County Center for Excellence. Through the Center for Excellence, new practices are tried in test plots for growers to learn and evaluate data, without it affecting their farming operation’s bottom line. The Center for Excellence, which began in 1998, is a research and testing program consisting of plots on two farms in Lenawee County; Bakerlads Farm and Raymond & Stutzman Farms. The plots test various production practices including conservation tillage, soil fertility levels and testing new seed genetics to determine how producers can increase productivity while conserving Michigan’s natural resources. The research projects and plots at the Center for Excellence are done over a period of time to ensure the most accurate data is obtained. “Corn and soybean farmers from across Michigan have benefited from check-off and privately funded research at the Lenawee County Center for Excellence for thirteen years,” said Clark Gerstacker, CMPM president, National Corn Growers Association Corn Board member and corn grower from Midland. “The Center for Excellence allows corn farmers to see the effects of the new agricultural innovations and techniques without having to assume the risk.” Each year, the Center for Excellence hosts a Field Day where farmers can learn more about the research being done at both locations and see the plots first-hand before harvest. This year’s Field Day was held on August 18 and focused on developing and refining viable conservation tillage systems that can be adopted on farms at a local level. The five

different tillage practices that were researched at the 2010 corn and soybean plots grown at Bakerlads Farm include:

1. Deep Tillage
2. Orthman Strip-Tillage
3. Dyna Drive Tillage Tool
4. No-Till
5. Disk-Ripper

After harvest, the Center for Excellence also holds a Yield Results meeting each January where the results of the research and the yields of all the test plots are reported. Highlights of 2009’s Yield Results meeting, held on January 8, 2010, featured data from the recently incorporated Livestock Reservoir Wetland Sub-Irrigation System on the Bakerlad Farms. To study the effects of the sub-irrigation system, testing has been conducted looking at the water quality of the system and the yield variability as a result of the sub-irrigation. The yield results on the sub-irrigation plots are shown in Table 3.

Sub-Irrigation Yield Variability					
	2005	2006	2007	2008	2009
Sub-Irrigated Corn	189.5	188.16	180	203.31	158.1
Non-Irrigated Corn	171.4	172	145.9	132.09	142.9
Yield Difference	18.1	16.16	34.1	71.22	15.2
The five year average for yield variability is 30.96 bushels/acre.					

Table 3: Sub-Irrigation plots

“The data compiled at the Center for Excellence each year continues to prove to be very valuable to Michigan’s nearly 12,000 corn farmers,” said Gerstacker. “We are grateful for their dedicated work and for the advancements their research encourages us to make on our own operations, so we can continue to see positive yield trends year after year as we strive to feed and fuel the world.”

Corn Yield Response to Nitrogen Rate and Timing

In order to improve the economic viability of Michigan’s corn industry, the CMPM looks for ways to improve production techniques so Michigan’s corn farmers can continue to grow more corn, on fewer acres and utilize fewer inputs. In order to improve farmers’ understanding of the factors that affect corn yield and yield response to nitrogen fertilizer in Michigan, the CMPM has partnered with Michigan State University (MSU) for two years to study corn yield response to nitrogen rate and timing in Michigan. Throughout the two year study, a total of 47 sites were studied. “The study was designed to investigate the mechanisms that drive corn nitrogen response, in order to better manage agronomic systems,” said Tim Boring, Assistant Researcher at MSU. Experimental site locations were chosen to provide a representation of the major soil types common in Michigan corn production. Plots were divided into basic and expanded plots. Each basic plot included six nitrogen rates applied as pre-plant broadcast incorporated urea. The

expanded plot designs included six nitrogen rates applied as pre-plant broadcast incorporated urea, starter fertilizer with planting and sidedress injected UAN.

Soil samples were collected preplant (0-6 and 6-12 inches from control plots) for site characterization. Pre-sidedress (0-12 inches) and post-harvest (0-6 inches and 0-3 feet in one foot increments) samples were also collected for evaluation. Plant growth evaluation included the following:

- stand counts
- V6 and R1 tissue sampling
- chlorophyll meter and Greenseeker optical sensor measurements at V6, V8, V10 and R1
- end-of-season stalk sampling
- grain yield and grain nitrogen analysis

Corn grain response to nitrogen for each individual site is listed for expanded sites and basic sites in Table 4. “At only two sites, Saginaw and Tuscola-Fairgrove, were nitrogen rate applications of 120 pounds per acre or less not sufficient to achieve maximum yield,” added Boring.

The research data has been added to the Iowa State University nitrogen rate calculator, so Michigan growers can now access and develop their own Michigan farm-specific nitrogen recommendations by entering information at the site: <http://extension.agron.iastate.edu/soilfertility/nrate.aspx>. The calculator allows growers to input their specific on-farm data to determine the most economical fertilizer nitrogen rate for their crop.

“If nitrogen costs \$0.40 per pound, a reduction of only 10 pounds per acre would result in an \$8 million input cost reduction in Michigan per year,” said Clark Gerstacker,

CMPM President and a corn grower from Midland. “By utilizing the new recommendations, farmers can ensure their corn plants receive only the necessary nutrients needed to maximize yield, while also protecting their bottom line.”

Fungal Endophytes May Reduce Irrigation Costs for Michigan Corn Growers

Drought conditions can have a devastating effect on crops and cause much concern for Michigan corn farmers. From 1998 to 2001, Michigan experienced a series of droughts that caused considerable damage to the corn crop and in some cases, even destroyed it. Identifying methods to effectively protect crops from these harsh conditions is essential and Dr. Carl Freeman, a researcher from Wayne State University, has been actively studying corn plants subjected to drought. In his efforts to try and find a defense against nature’s unpredictability, Dr. Freeman has partnered with the CMPM to measure the benefits of fungal endopyhtes grown on corn crops in drought conditions.

Fungal endophytes are tiny organisms that live within plant tissues for all or most of their life cycle without causing disease. They gain entry into plant tissue through natural cracks, wounds and in the plant itself from air current, rain water or through various insects and bugs living within the plants. Studies of endophytes have proven they are beneficial to host plants by altering the plants’ characteristics. One such study of field trials conducted by Precision Laboratories Inc. found that wheat plants inoculated with endophyte spores enhanced their field trial yields.

Data has confirmed selected endopyhtes may include

		Saginaw	Ingham	Ingham	Branch	Hillsdale	Kalamazoo	Tuscola - Reese	Tuscola - Fairgrove
<i>lb/acre</i>		<i>bu/acre</i>							
0		88	96	77	76	97	49	89	61
40	Bc	134	150	102	88	127	62	133	117
80	Bc	194	132	127	94	167	71	162	152
80	(40/40)	190	164	111	88	168			
120	Bc	211	157	161	87	187	55	173	177
120	(40/80)	211	152	137	96	188			
160	Bc	233	184	129	88	190	57	180	180
160	Sd	226	155	127	98	197			
160	Bc	223	167	152	97	187			
160	Sd	231	176	142	86	191			
160		223	167	152	97	187			
200	Bc	231	176	142	86	191	49	187	207
Previous Crop		Soybeans	Soybeans	Corn	Soybeans	Soybeans	Soybeans	Soybeans	Soybeans
Treatment Type		Expanded	Expanded	Expanded	Expanded	Expanded	Basic	Basic	Basic
Agronomic Max (Max yield and corresponding Nitrogen rate)									
Yield (bu)		228	172	144	91	190	64	182	201
Nitrogen Rate (lb)		173	192	138	79	163	92	156	212

Table 4. Corn grain response to Nitrogen Fertilizer

the ability to resist pathogens, aid in the growth and reproduction of plants, and contain heat and drought tolerance. While these traits are useful to corn plants, not all beneficial fungal endophytes are present in every corn field. As one of the many problems faced by farmers is drought stress, finding the right combination of beneficial endophytes to help corn plants utilize water and withstand drought could lead to increased plant efficiency. With this in mind, Dr. Freeman saw great potential for fungal endophytes to increase crop protection and improve the U.S. corn crop.

In hopes of finding the fungal endophytes that offer the best crop protection, Dr. Freeman studied four field corn test plots and four sweet corn test plots. Each plot contained two control groups to measure root biomass and fluid usage. The field corn plants were inoculated with collectotrichum and curvularia endophytes, while the sweet corn plants were inoculated with fusarium endophytes. Once the plants were inoculated, the amount of water and biomass were measured for the duration of ten days. During this time, plants were subjected to drought and salinity stress. The corn plants were grown in sand and drought stressed for ten days. On the tenth day, water was added to allow plant recovery. For salinity stress, plants were watered with 300 millimeters of sodium chloride.

After ten days, Dr. Freeman concluded all three fungal endophytes appeared to provide significant benefits under the salinity and drought conditions compared to the non-inoculated plants. While all three endophytes proved to be beneficial, the results indicated considerably less fluid usage and healthier, larger root biomass from the collectotrichum endophyte. This trait is important to corn farmers because the larger the root biomass, the more efficiently a plant may retain fluid during droughts.

Figures 2 and 3 analyze the difference between the field corn plants inoculated with collectotrichum and curvularia endophytes versus the non-inoculated field corn plants. Figure 2 describes the fluid usage while Figure 3 illustrates the increase of root biomass. While these results are encouraging, there is a great deal of research and development still needed before a product that benefits growers is available.

“The CMPM realizes this research is long-term, but as the agriculture industry is called upon to produce more food, feed and fuel with a lower environmental footprint,

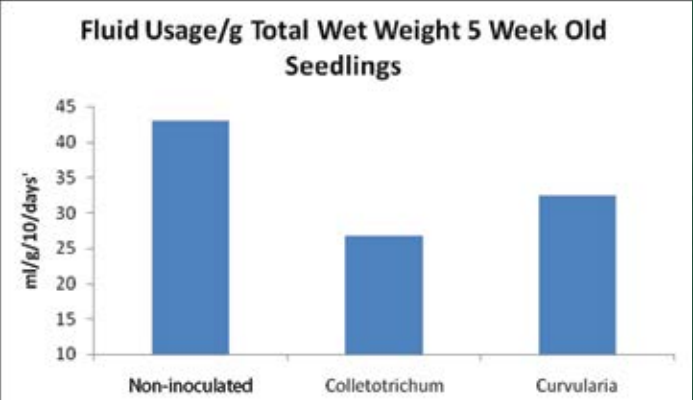


Figure 2. Fluid usage in control and inoculated plants

research of this type must begin today. The CMPM is always pursuing research for the next break through in corn development. Reducing our environmental footprint is one of our top priorities and that is what research like Dr. Freeman’s helps us do,” said Clark Gerstacker, CMPM president, National Corn Growers Association Corn Board member and corn farmer from Midland, Mich.

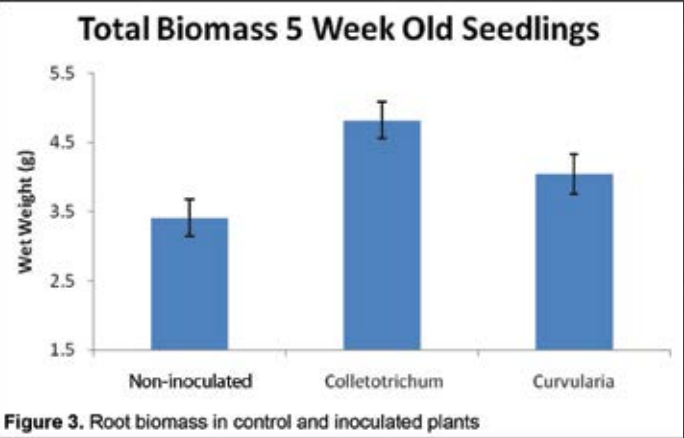


Figure 3. Root biomass in control and inoculated plants

Benefits of Reduced Tillage

In an effort to continue arming Michigan’s corn farmers with information on how they can grow corn in a more efficient and environmentally-friendly manner, the CMPM recently conducted a tillage study. The study compared conventional tillage to strip-tillage and no-till practices.

Four farms were selected for the study. Soil samples were taken from each site as needed, as well as the collection of stand counts, field observations and yield results. The data from three of the four farms was used for the final results.

The first location in Burlington, Mich., compared conventional tillage to strip-tillage on two fields. Both fields saw better field stand in the conventional tilled corn, as opposed to the strip-tilled corn. A 24-row planter was used with a 16-row strip-till bar. When run on the row, the populations were similar to conventional tilled corn, 29,000-30,000 seeds. When the planter was off the strip, populations dropped considerably, down to 23,000 seeds. The conventional corn averaged 178 and 179 bushels per acre, with populations of 28,000 and 31,500 per acre; while the strip-till averaged 183 and 184.6 bushels per acre, with populations of 26,000 and 28,500 per acre.

The second location was in Allen, Mich. and compared strip-till to no-till on three fields. The strip-till corn averaged 162.4, 155.3 and 155.2 bushels per acre with populations of 26,300, 27,800 and 26,600 respectively. The no-till corn averaged 150.6, 151.6 and 147.5 bushels per acre with seed populations of 26,300, 22,800 and 27,500 respectively. These lower yields can partially be attributed to weeds and other problems. “There were several areas within the no-till corn that had wet holes and severe dandelions,” said Bill Moyer, a crop consultant with LFB Solutions, Inc., who helped with the study.

The third location in Homer, Mich., also compared strip-till to no-till. On sandy soil, the strip-till averaged

162.1 bushels per acre with a population of 32,600 per acre; while the no-till averaged 167.3 bushels per acre with a population of 32,250 per acre. On heavier soil, the strip-till averaged 192.7 bushels per acre with a population of 31,000; while the no-till averaged 187.5 bushels per acre, with a population of 31,600 per acre.

The fourth location selected for the study was in Union City, Mich. and ran into adverse planting conditions for the strip-till corn. “The strips were in heavy clay soils, which received an excessive amount of rain prior to planting, leading to severe crusting,” explained Moyer. “As a result, the seed trench was unable to be closed when planting on the strips. The conventional tillage done just before planting gave a better stand as the cooperator was planting into loose dirt.” As a result of the poor planting conditions, yield data from this location was omitted from the final results, which are shown in Table 5

Yields Received at Each location			
Cooperator	Strip Till <i>bu/acre</i>	Conventional Till <i>bu/acre</i>	No Till <i>bu/acre</i>
Burlington	183	179	
	184.6	179	
Allen	155.3		151.6
	155.2		147.5
Homer	162.1		167.3
	192.7		187.5

Table 5: Yield results

“Based on the results we received, it appears that strip-tillage provides a small yield advantage over conventional tillage or no-tillage,” concluded Moyer. “However, strip-till only has an economic advantage when compared with conventional-till, garnering \$33 more an acre. Strip-till methods resulted in a decrease of \$6.55 per acre when compared to no-till corn.” Tables 6 and 7 detail the associated costs under each practice and the resulting net income.

“While strip-till does result in additional income for some farmers who switch from conventional tillage, it also comes with some associated negatives. The shank used on the strip-till equipment brought many rocks out from under the surface,” said Moyer. “It would be worth investigating strip-till rigs that do not use the shank, and as a result do

	Strip Till	Conventional Till	No Till
Equipment	Strip rig \$20.00/\$20.00	Chisel/disk \$36.00	Add. Planter \$3.00
Drying at \$.10/bu	\$18.37/\$16.63	\$17.90	\$16.30
Hauling/ Storage at \$.15/bu	\$27.56/\$24.95	\$26.85	\$24.53
Total	\$65.93/\$61.58	\$80.75	\$43.83

Table 6: Associated costs for each tillage practice

	Strip vs. Conventional		Strip vs. No Till	
	Strip Till	Conventional Till	Strip Till	No Till
Yield at \$4.00	\$734.80	\$716.00	\$665.20	\$654.00
Less cost	-65.93	-80.75	-61.58	-43.83
Net income per acre	\$668.87	\$635.25	\$603.62	\$610.17
	Strip Till Advantage +\$33.62/acre		Strip Till Advantage -\$6.55/acre	

Table 7: Net income received for each tillage practice

not disturb as many rocks.”

Clark Gerstacker, CMPM president and corn farmer from Midland, was pleased to see the results from the study. “Michigan corn farmers are constantly trying to improve their practices, not only for efficiency, but also to reduce their impact on the land,” said Gerstacker. “This study will show farmers that not only is there an environmental benefit to reduced tillage methods, but there can also be a cost savings for them. We are grateful to have research like this that helps corn farmers have an economic advantage while continuing to be great stewards of the land.”

Sampling Corn and Soybean Field Pairs for Variant Corn Rootworm

Rotation-resistant, also known as variant, corn rootworm (CRW) was first reported in Illinois nearly fifteen years ago. Variant CRW lays eggs in soybean fields and then attacks corn the following year. Rootworm larva tunnel into the roots of corn plants, which can lead to lodging, and adults feed on plant silks, which can interfere with pollination. CRW was first identified in Michigan in 1997 but its spread north and east has been slow. The last CRW sampling was conducted in the early 2000s and results showed variant damage was still generally confined to the state’s southwest counties.

In order to help Michigan’s corn farmers determine if the area of CRW variant behavior and damage has moved, particularly into central Michigan, the CMPM partnered with MSU to conduct a CRW study. The main objectives of the study were to determine the severity and geographical distribution of rotation-resistant CRW and to detect if first-year corn damage in isolated areas is variant.

To accomplish these objectives, Dr. Chris DiFonzo, principal researcher and professor of entomology at MSU, setup a CRW sampling system throughout Michigan. The system included seventeen adjacent corn and soybean field pairs from southwest Michigan into the Thumb region. Rootworm adults were sampled weekly in both fields from early July until the end of August. Additionally, corn roots were dug in early August from each field to check the severity of damage.

In the soybean fields, four yellow sticky traps were placed on poles and twenty-five sweeps were taken between each trap, for a total of one hundred sweeps. There is no threshold based on sweeps for CRW adults in soybeans. However, an elevated sweep catch in soybeans

show large scale movement from corn and is generally recognized as a sign of variant behavior. Elevated catches were evident in all the fields in Clinton County and no adults were found in soybeans in the Thumb. When using the yellow sticky cards in soybeans, a catch of five or more beetles per day is the threshold for CRW adults. Although sweep net catches were high in some fields, no soybean fields were over threshold based on sticky cards.

In the corn fields, four yellow sticky cards were placed on plants, emergence cages were placed near the sticky cards and visual counts were taken on fifteen plants around the cards and cages, for a total of sixty visual counts. There is no threshold for CRW based on emergence cages; however, rootworms emerging from first-year corn are an indication that eggs were laid the previous year in soybeans which is a sign of variant CRW. Rootworm emergence only occurred in first-year fields in Clinton County.

Visual counts in corn are used to predict the need for insecticide the next season if the field is kept in corn. The threshold is one beetle per plant in established corn and 0.75 beetles per plant in first-year corn. Three first-year fields in Clinton County were over threshold. The threshold for sticky cards in corn is a catch of 20 or more beetles per week. The three fields in Clinton County that were over threshold visually were also over threshold on sticky cards. Two additional fields were over threshold on the cards, although populations were less.

To check the severity of CRW damage in the corn fields, roots were rated in early August. Root ratings are an after-the-fact measure of CRW pressure. The first number

County NE to SW	Location	SOYBEAN		CORN			
		Sweep Net	Yellow Cards	Emergence Cage	Visual Count	Yellow Cards	Root Rating
Tuscola	Colling Rd	0	0	0	0	1	0
Tuscola	Sheridan Rd	0	0	0	0	0	0
Tuscola	Bradford Rd	0	0	0	0	3	0
Saginaw	Roedel Rd	0	1	0	0.2	4	0
Clinton	Wright Rd	82	13	3	0.2	18	0
Clinton	Walker Rd 1	280	19	86	1.6	96	0.1
Clinton	Walker Rd 2	44	7	0	0.2	27	0
Clinton	Wacousta Rd	201	21	36	1.7	112	0.2
Clinton	Forest Hill Rd	387	18	20	1.5	115	0.1
Clinton	Essex Center Rd	80	16	9	0.4	15	0.1
Clinton	Bauer Rd	69	19	1	0.3	57	0
Ingham	MSU	39	6	22	0.3	14	0
Van Buren	92nd St	0	0.2	0	0.05	1.5	0
Van Buren	96th St	0	2	0	0.1	9	0
St. Joseph	Spring	0	0	0	0	0.2	0
Cass	Dewey Rd	1	3	0	0.03	0.8	0.1
Cass	Mt. Zion Rd	11	1.5	1	0.6	7	0.1
THRESHOLDS		n/a	35	n/a	0.75	20	0.5

Table 8: Data cells in pink highlight counts or catches that are over standard thresholds, listed in the last line of the table.

in the 0 to 3 rating scale measures whole nodes removed; 0, 1, 2 or 3. The second number, following the decimal point, measures root pruning, 0.1 to 0.9. Ratings under 0.1 indicate only incidental feeding and a rating of 0.5 or higher indicates that there is likely economic damage from CRW feeding. Despite the elevated CRW numbers, damage was not over threshold in any field. However, root pruning was found in fields in Cass and Clinton counties.

Table 8 summarizes the data collected from the seventeen corn and soybean field pairs.

The final results of the study show that despite ten years of variant behavior in Michigan, damage from variant CRW in first-year corn remains low and rootworm control is not justified. In isolated areas with silage production, such as parts of Clinton County, rootworm movement is enhanced and the risk of damage is greater in first-year corn. However, it appears that CRW populations increase quickly in first-year corn, putting second-year corn at risk. The impact of variant behavior in Michigan may thus not be so much damage to first-year corn, but instead quicker buildup of CRW populations in first-year corn, leading to risk of damage in second-and third-year corn.

“As a result of this study, Michigan’s farmers are better informed regarding the spread of variant corn rootworm and the severity of damage it causes,” said Clark Gerstacker, CMPM president, National Corn Growers Association Corn Board member and a corn grower from Midland. “We are grateful for the work Dr. DiFonzo has done regarding CRW. The results from her project will help farmers across the state increase their productivity and decrease their losses.”

NEW USE DEVELOPMENT

The CMPM works to stretch check-off investments by not only focusing on production research and enhancing traditional markets, but also by creating new and innovative markets for corn. The CMPM works with a diverse group of partners across the U.S. to look five, ten and even twenty years into the future to identify new markets and possible uses for Michigan corn. Check-off funded research has led to many new corn use developments including pharmaceuticals, ethanol and engine oil.

Improving the Nutritional Value of Distillers Grains

Michigan's farmers are predicted to have harvested approximately 335 million bushels of corn this fall. As farmers look out at their grain bins filled with America's renewable resource – corn – they think of all the ways their crop will be utilized. Since livestock is still the number one user of Michigan corn, the CMPM invests check-off funding to ensure corn and corn co-products have exceptional nutritional value.

Corn and distillers grains are staple components in the diets of both poultry and swine. "However, these non-ruminant animals do not digest fiber well," said Dr. Radhakrishnan Srinivasan, an assistant research professor at Mississippi State University (MSU). "As a result, research was conducted to increase the nutritional value of dried distillers grains with solubles (DDGS) and ground corn flour by separating fiber through an Elusieve process, a combination of elutriation (air classification) and sieving (screening)."

Through the Elusieve process, DDGS were screened into four different sizes: pan, small, medium and large. Figure 4 shows the schematic of the Elusieve process. The pan DDGS contain less fiber and are only 35 percent the weight of original DDGS. "Pan DDGS have 5 percent higher protein content than conventional DDGS," added Dr. Srinivasan. The fiber was removed from the three biggest sizes by air classification. The remaining materials from the three largest sizes were mixed together and are called "big DDGS". These big DDGS are 55 percent the weight of original DDGS. Big DDGS have nearly the same protein content as conventional DDGS.

In the feeding study, birds fed with 8 percent pan DDGS showed a significant difference in body weight as compared to birds fed the conventional DDGS. However,

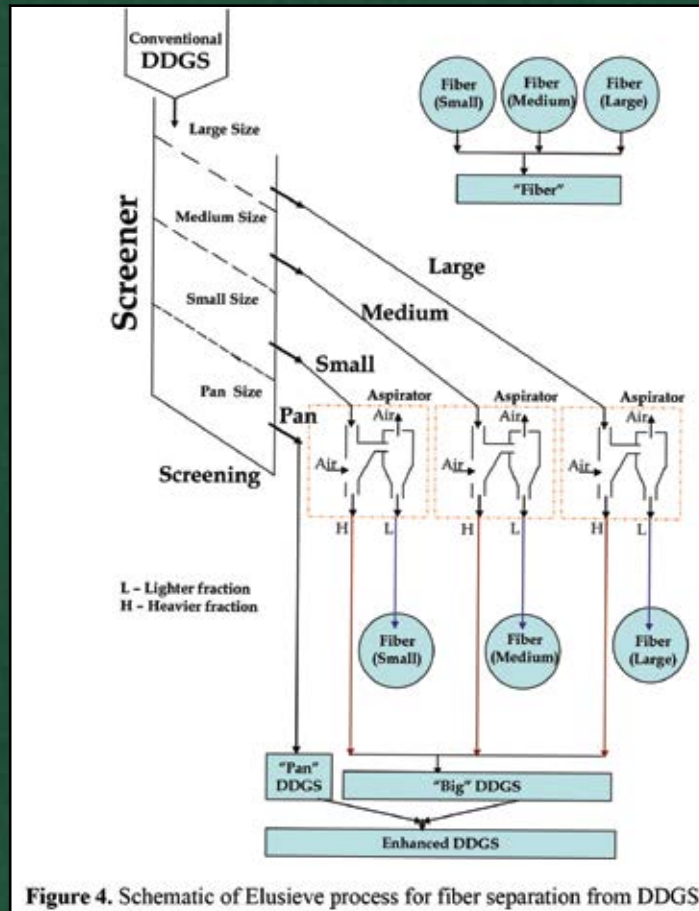


Figure 4. Schematic of Elusieve process for fiber separation from DDGS

there was no significant difference in body weight for birds fed big DDGS as compared to the conventional DDGS. Table 9 shows the performance of male broilers up to 21 and 42 days of age on the various feed treatments. In addition, the study looked at pellet quality (pellet durability index; PDI) for broiler diets comprising of pan DDGS

	0 to 21 days of age				0 to 42 days of age			
Treatments	BW (g)	Feed Intake (g/bird)	FCR	Mortality (%)	BW (g)	Feed Intake (g/bird)	FCR	Mortality (%)
C/SBM	736	1,248	1.56	4.2	2,793	4,947	1.742	5.6
UMD	750	1,276	1.542	0.7	2,834	4,979	1.736	1.7
PMD	738	1,259	0.543	3.5	2,801	4,867	1.74	5.6
ED	765	1,294	1.537	2.1	2,907	5,059	1.72	4.9
SEM	12.6	18.3	0.015	1.19	28.6	48.3	0.007	1.69
P Value	0.37	0.33	0.54	0.18	0.03	0.05	0.11	0.14

Table 9: C/SBM refers to the control diet, UMD refers to the diet containing unmodified dried distillers grains with solubles (DDGS), PMD refers to the diet containing big DDGS and ED refers to the diet containing pan DDGS. The values above represent the feed to gain ratio after being corrected for mortality.

(both 10 and 20 percent inclusion levels). The results showed that PDI with pan DDGS was significantly better than PDI for diets comprising conventional DDGS, big DDGS and the diet without DDGS. "Thus, fiber separation from DDGS results in a product, pan DDGS, which has higher nutritional value for broilers compared to original DDGS and the pan DDGS have better feed processing characteristics than regular DDGS because it produces better quality pellets," noted Dr. Srinivasan.

In the Elusieve process for ground corn flour, the nonfiber fractions from aspiration of the three largest size fractions and the pan size fraction are combined to create an enhanced corn flour. Enhanced corn flour is nearly 95 percent the weight of the original corn flour and contains 3-5 percent higher starch content than the original.

The research showed there was a significant increase in body weight gain for broilers fed with enhanced corn flour compared to broilers fed with regular corn flour. The body weight gain was 4.3 percent higher for the enhanced corn diet compared to the regular corn flour diet. According to Dr. Srinivasan's research, the incorporation of fiber separation from corn flour in poultry feed mills could be helpful in increasing revenues from poultry production.

By using the Elusieve process for fiber separation from ground corn flour, we can create a product with higher nutritional value.

"While the CMPM is always striving to find new and innovative uses for corn, we also understand the importance of strengthening and enhancing our traditional markets, such as livestock feed," said Clark Gerstacker, CMPM president and a corn farmer from Midland. "Since 24 percent of Michigan's corn is used to feed our state's livestock, the CMPM is working hard to provide products with improved nutritional value."

Michigan's Corn Farmers Showcase the Use of Ethanol as a Performance Fuel

Corn farmers have long known the value of their crop as not only a livestock feed, but also as a fuel. Ethanol, 200 proof alcohol, is a renewable fuel made from corn. It has been used mainly in automobiles, but is now being looked at for use and increased performance of snowmobiles. The CMPM has been the proud sponsor of the SAE Clean Snowmobile Challenge and of the Kettering University team to highlight the use of ethanol.

Michigan has provided a winter wonderland for hundreds of thousands of snowmobile enthusiasts each year. Now, thanks to cooperation between the CMPM and Kettering University, snowmobilers will soon have the option of using fuels that will actually help to keep Michigan's trails and environment in pristine condition.

The CMPM has partnered with Kettering University for more than seven years to study the concept of using ethanol in recreational vehicles. In 2009, the study focused on transforming a stock Yamaha Phazer GT snowmobile into a flex-fuel snowmobile, with the ability to run on any blend of gasoline and ethanol up

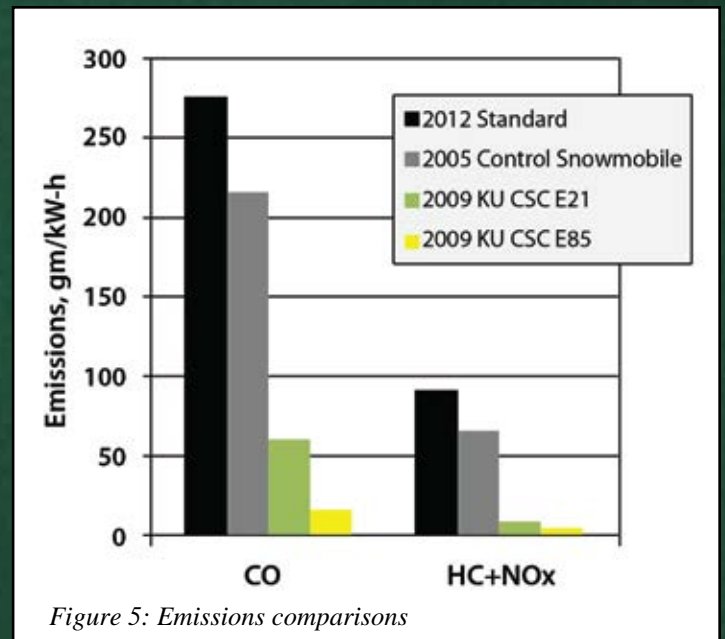


Figure 5: Emissions comparisons

to E85 (85 percent ethanol and 15 percent gasoline). Kettering University students studied the effects and benefits of using ethanol through the development of a cleaner and quieter snowmobile for the Clean Snowmobile Challenge. The CMPM has been supportive of Kettering University not only for the exposure of engineering students to ethanol, but also as a way to educate the public on the use of ethanol-blended fuels in snowmobiles.

"Thanks to the support of sponsors like the CMPM, we've been able to research the use of ethanol-blended fuels in recreational vehicles such as snowmobiles," said Dr. Greg Davis, a professor of Mechanical Engineering and competition advisor at Kettering University. "We have as many as 20 students working on this project year-round, and it gets them excited to be able to work on real-world problems and find solutions that can really make a difference."

For the Clean Snowmobile Challenge, teams of engineering students from participating schools take a stock snowmobile and re-engineer it to reduce emissions and noise while maintaining or improving performance. The teams converge in Houghton, Mich. for the contest. The goal of the challenge is to design a snowmobile with reduced emissions and noise characteristics that also equals or improves upon the performance of current snowmobiles. Teams compete in a variety of events including emissions, noise, acceleration, fuel economy/endurance, subjective and objective handling/drivability, cold starting, cost and overall design. This year, the Kettering University team had great success in several categories, placing third in the emissions event, design presentation and design report.

"With the snowmobile operating on E85, we achieved significant improvements over the 2012 emissions requirements," added Davis. "We saw a 94 percent reduction in carbon monoxide and a 92 percent reduction

Snowmobile/ Standard	CO, g/kW-hr	HC + Nox, g/kW-hr
2012 Standards	275	90
2009 KU E85	17	7
% Reduction	94%	92%

Figure 6: Emission reductions for the E85 powered snowmobile.

in hydrocarbons and nitrous oxides.” These reductions are shown in Figures 5 and 6.

“This is something we’re very pleased to be a part of,” said Clark Gerstacker, CMPM president and a corn farmer from Midland. “Any automobile can use a blend of 10 percent ethanol, but it’s important that innovative work, like that by Dr. Davis and his team, continues to show the benefits of using ethanol in other vehicles as well. It’s always exciting to work with students in this capacity. Today’s students are tomorrow’s engineers, so it’s important they develop an understanding of alternative fuels now.” Gerstacker is also a member of the National Corn Growers Association Corn Board.

Making Adhesive from Dried Distillers' Grains

As Michigan’s economy began to go “green” and ethanol production increased within our state, the CMPM began looking at research projects that would provide novel products and markets to utilize the influx of Distillers’ Dried Grains with Solubles (DDGS) and add an additional revenue stream for ethanol plants.

Many starch adhesives are readily available in today’s marketplace. These adhesives, typically used to make corrugated boards and boxes, are easy to apply from water dispersion at a relatively low cost. However, starch adhesives have one large drawback – they fail when exposed to moisture. Therefore, alternatives are being researched to replace starch adhesives with newer products that are not as sensitive to water. These alternatives are able to be utilized for moisture sensitive applications and often can garner an increased price. Therefore, a low cost adhesive, with improved water resistance is highly desirable.



Figure 7. The DDGS adhesive created in the Dr. Rafael Auras research study.

The CMPM has been working with Dr. Rafael Auras, a professor in the School of Packaging at Michigan State University, to look at whether a DDGS-based adhesive could provide similar performance to conventional starch-based adhesives at the same cost or less, with higher resistance to loss of performance due to exposure to water or moisture.

In order to determine the market feasibility of creating a commercially viable DDGS-based adhesive, Dr. Auras looked at several factors to determine how the DDGS-based adhesive would compare to traditional starch adhesives. In order to be marketable and competitive, the resulting product would need increased lap shear strength, so Dr. Auras looked at the effect varying heating temperatures and cooking time had on the production and strength of the DDGS-based adhesive.

“Our research showed that the production of DDGS adhesive is directly influenced by the heating time and heating temperature,” said Dr. Auras. “Varying levels of hydroxide solution is an important factor influencing the production and the lap shear strength of the DDGS adhesives and an increase in the solution can increase both the output and the lap shear strength of the adhesive. Using DDGS in the preparation of adhesives can provide a new approach for effective use of ethanol co-products.”

Lap shear strength affects the strength of the commercially-made joint, and it often indicates the ability of a joint to withstand rough handling without failure. One of the important factors affecting lap shear strength of bio-adhesives is the relative humidity and the sensitivity of the bio-adhesive to water. Utilizing DDGS, the lap shear strength of starch adhesive was compared to DDGS-based adhesives. When compared with the starch based adhesive, the lap shear strength (psi) of the DDGS adhesive at 50 percent relative humidity was slightly lower. The lap shear strength at 25 and 75 percent relative humidity was significantly lower for DDGS adhesive than the starch adhesives. Values for the water resistant starch adhesive were higher than the regular starch adhesive at 50 and 75 percent relative humidity, and were much higher than the DDGS adhesive at all relative humidities tested.

Additional research is necessary to determine if a more stable and increased water resistance formulation can be obtained utilizing DDGS.

“As we look toward the future, it is exciting to be part of an organization on the cutting edge of technology,” said Clark Gerstacker, CMPM president and a corn grower from Midland. “Corn is such a versatile crop and can be used to replace almost any petroleum-based product. As corn farmers continue to grow record-setting crops, Michigan is in an excellent position to continue meeting the needs of not only our livestock industry, but also for feed, fuel and now adhesives.” Gerstacker also serves as a member of the National Corn Growers Association Corn Board.

Using Corn for Salaad Containers

The offering of fresh salads has multiplied rapidly at fast-food restaurants as an attempt is made to satisfy the growing demand for fresh and convenient foods. Since there is a growing interest in these foods, the top three fast-food chains, McDonald’s, Wendy’s and Burger King, have increased sales in fresh salads. In 2003, McDonald’s introduced the Premium Salad line, selling more than 133 million salads in the first year. Burger King’s salad bars captured 6 percent of unit sales chain-wide during their first year on the market.

Although a huge variety of salads are offered, green salads (based on lettuce mixed with other veggies or meat) are the most demanded by consumers. “Today, salads at fast-food restaurants are packaged in petroleum-based plastic containers, with polystyrene being the most used packaging material,” said Eva Almenar, Assistant Professor in the School of Packaging at Michigan State University (MSU).

In addition to fast-food restaurants, packaged fresh-cut vegetables (lettuce and other salad vegetables) are becoming more popular in supermarkets and grocery stores because they are convenient and ready-to-eat. At this point in time, these traditional containers are disposed of in a landfill, contributing to the increase in plastic waste. “Since corn-based packages are both compostable and biodegradable, their use may be an effective environmental solution to reduce landfill waste,” added Almenar, who is also the lead researcher on this project.

In order to determine the effectiveness of corn-based plastic containers as a new packaging system for fresh-cut salads for fast-food restaurants and supermarkets, the CMPM has partnered with MSU. “Through the work of Ms. Almenar at MSU, we were able to conduct several comparisons of polystyrene and corn-based plastic containers,” said Clark Gerstacker, CMPM president and a corn grower from Midland.

For the study, fresh-cut romaine lettuce was packaged

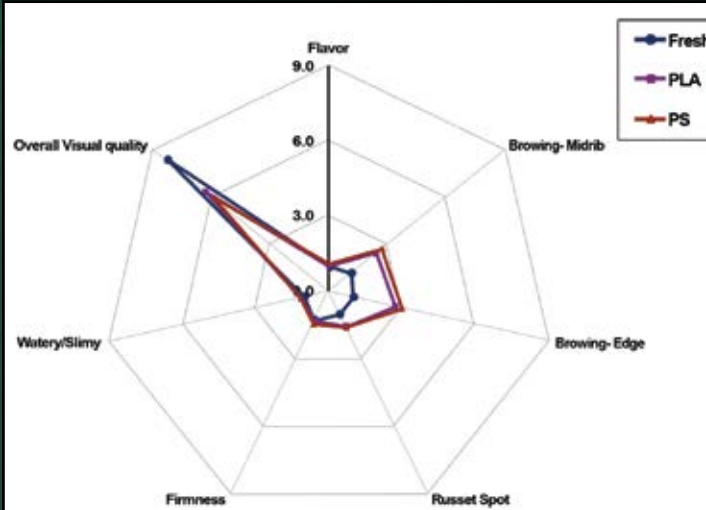


Figure 8. Sensory data of fresh-cut lettuce stored for 1 week.

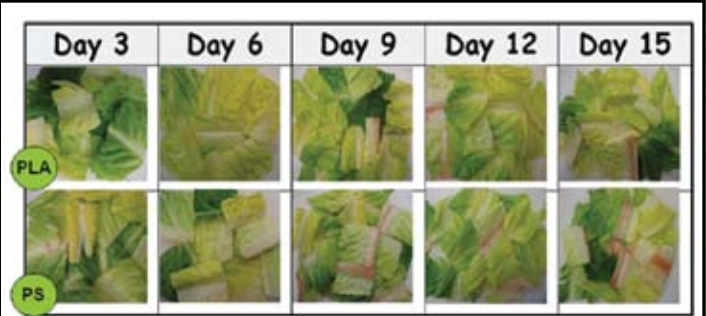


Figure 9. Browning evolution in edges and midribs of fresh-cut lettuce stored for 2 weeks.

in a corn-based polylactic acid (PLA) plastic and in polystyrene containers and then stored for 24 hours at 32-35 °F, or one week at 50-55°F. The oxygen and carbon dioxide concentrations, texture, pH, microbial population, volatile profile, moisture content, color and sensory evaluations of fresh-cut lettuce in PLA and polystyrene containers were analyzed.

The results of the sensory evaluations for the fast-food restaurant applications showed the same results. The evaluations included flavor, overall visual quality, watery/slimy, firmness, russet spot, browning edge and browning in midrib in fresh-cut lettuce stored in PLA and polystyrene containers for one day.

Figure 8 shows the sensory quality attributes of flavor, watery/slimy, firmness, and russet spot of fresh-cut lettuce stored in PLA and polystyrene containers for 1 week. Trained panelists were able to distinguish between lettuces from PLA or polystyrene containers in terms of browning edges and browning midribs. The results observed by the trained panel are shown in Figure 9. A higher overall visual quality was attributed to the lettuces from the PLA container. However, this overall quality was lower than that presented at day 0, which presented a maximum overall quality.

“Throughout our research, we found that corn-based containers could easily replace polystyrene packages for fresh-cut lettuce,” noted Almenar. “Our results showed that fresh-cut romaine lettuce packaged in PLA containers can be considered as fresh as fresh lettuce after 24 hours at 37.4 °F and during 4 days at 50 °F.”

“Corn has always been such a versatile crop,” added Gerstacker, who also serves on the National Corn Growers Association Corn Board. “Corn farmers in the United States have been able to grow and harvest record crops, utilizing fewer acres and inputs, and are able to meet the growing demand of not only livestock, but also of food, fiber and fuel. Now, I’m excited to say we can add plastics to that list.”

Total Renewable Biodiesel Production from Ethanol and Vegetable Oil

Ethanol production in the United States continues to increase, so it is important to fund new ways to utilize the fuel and expand the market. New research from Wayne State University (WSU) has found a way to tap into another market by using ethanol in the process



to make biodiesel which is replacing or supplementing traditional petroleum diesel. In a two-year partnership with the CMPM, WSU researchers Drs. K.Y. Simon Ng and Steve Salley have developed an innovative technology to produce a completely renewable biodiesel using ethanol.

Biodiesel is a renewable fuel for diesel engines derived from vegetable oils and animal fats. Today, much of this biodiesel is produced using soybean oil. In order to convert ordinary vegetable oil into biodiesel, alcohol and sodium hydroxide must be added to begin the transesterification process through which biodiesel is produced. In this process, vegetable oil is the acid, alcohol is the base and the sodium hydroxide is the catalyst for the chemical reaction. Under the present standards, the type of alcohol which should be used in biodiesel production is not specified and most of the alcohol currently used is methanol. Methanol is derived from fossil fuels which are not renewable and contribute to a net carbon dioxide generation.

In their research, Drs. Ng and Salley used a unique biodiesel reactor that easily completed the transesterification reaction between vegetable oil or soybean oil and ethanol, thus producing a completely renewable biodiesel. Using ethanol versus methanol for biodiesel production offers greater benefits because it is significantly less toxic and made from an annually renewable resource, corn. This makes ethanol an ideal candidate for replacing or supplementing methanol for biodiesel production.

Alternative fuels like ethanol have become an important focus in recent years due to the increased concern for the environment, fear of global warming as a result of fossil fuel use and efforts to become more energy independent. However, most of this ethanol has been used to replace regular unleaded gasoline, primarily in the form of E10, which is a fuel blend of 10 percent ethanol and 90 percent gasoline. This blend can be used by every make and model vehicle on the roads today. Diesel markets, on the other hand, have remained virtually untouched by corn-based ethanol, but the research done by Drs. Ng and Salley is likely to change this. By breaking into the biodiesel market and expanding the usage of ethanol in the energy sector, this research will bring more business opportunities and profitability to corn farmers.

Besides opening doors to new markets, Drs. Ng and Salley's novel process does not involve neutralization or washing and drying steps and can be operated at lower temperatures, thus significantly reducing the production

cost of biodiesel. Removing these steps also lowers the level of contaminants in the production process which allows the biodiesel co-product, glycerin, to generate additional profit for biodiesel producers and it diversifies their income stream.

"It's always exciting to see new advances in alternative fuels. This biodiesel reactor is cutting edge technology that will not only create a completely renewable fuel, but an economical one as well, and that is something to be proud of," said Clark Gerstacker, CMPM president, National Corn Growers Association Corn Board member and corn farmer from Midland.

Corn Powered Locomotive Still on Track in 2010

The CMPM strives to create partnerships with companies and other organizations for the betterment of Michigan's corn industry. Throughout the past year, the CMPM has been working with AHL-TECH as they develop the world's first cost-effective, ethanol-electric hybrid locomotive.

"AHL-TECH has developed an ethanol-hybrid locomotive to capitalize on the growing ethanol market in the United States and to replace the railroad industry's aging diesel-electric locomotive fleet," said Tom Mack, president and CEO of AHL-TECH. The current diesel-electric locomotives that form the backbone of the railroad fleet range from 1,000 to 4,400 horsepower (hp). The diesel engines are connected to large generators that drive electric motors that are directly attached to the locomotive's axles.

Much like diesel-electric locomotives, an ethanol-fueled engine powers a generator connected to the locomotive's axles. However, unlike the diesel-electrics, AHL-TECH's ethanol-hybrid also has a battery component. Instead of a direct correlation between the speed of the engine and the power transmitted by the generator, AHL-TECH's design features the capacity to store electricity when the generator produces more power than is being used. This gives the locomotive the ability to power the axles by running the engine or using power stored in the main battery. It also allows for regenerative braking – capturing the energy lost when a locomotive is brought to a halt.

AHL-TECH completed the overall design of a 4,000 hp, 6-axle locomotive (3,000 hp from six ethanol generators plus 1,000 hp from hybrid batteries) in 2008. This high horsepower locomotive, shown in Figure 10, features a brand new AHL-TECH designed cab and frame, meeting all 2009 crashworthiness requirements for U.S. locomotives. In addition to the high horsepower locomotive, AHL-TECH has also designed a package to retrofit low horsepower (1,000-1,500 hp) switcher locomotives utilizing the same components as the higher horsepower locomotive. "We are very excited about the potential to retrofit hundreds of extremely old switcher locomotives in the United States with clean, 21st century ethanol technology," said Mack.

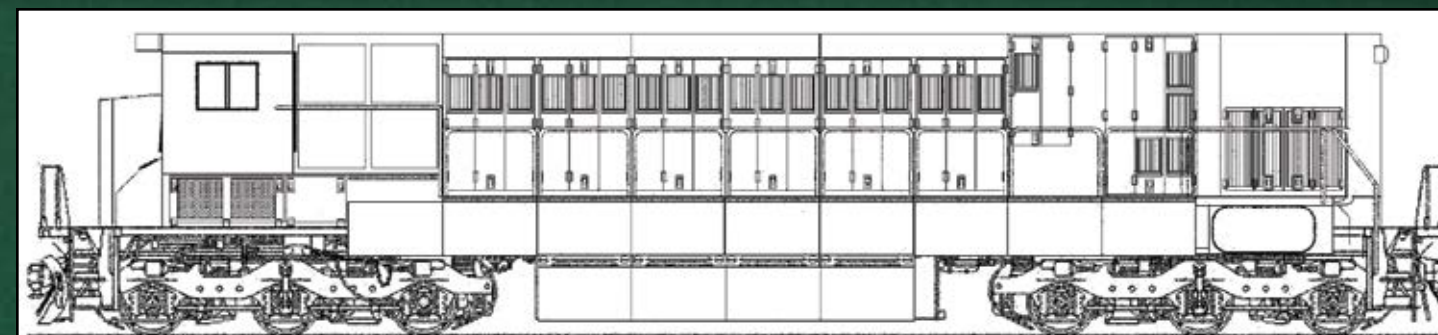


Figure 10. Design of the high horsepower locomotive.

Since completing its low and high horsepower designs in 2008, AHL-TECH has continued its development, education and sales efforts for its revolutionary line of ethanol-electric hybrid locomotives. In 2009, AHL-TECH was able to carry out two key steps in the development of its hybrid locomotive; major studies on both the battery system and the EMCap energy storage system.

The EMCap study was performed by the University of Toledo and the Compressor Control Company of Chelsea, Mich. The result of the study was a definitive bill-of-materials, energy duration model and a completed cost model for the EMCap system.

The second study focused on the battery and included the manufacturing of the first prototype battery tray by Crown Battery of Fremont, Ohio, along with five in-depth testing cycles of the tray. "The testing showed that our use of low cost lead acid batteries is based on solid engineering and modeling," said Mack. "The batteries can definitely deliver the power needed and the economics are where we need them to be."

While the second study illustrated the feasibility of AHL-TECH's battery system, the recent economic downturn has helped to illustrate the marketability of the ethanol design. The recent volatility of oil markets, with sudden spikes over \$140 a barrel and abrupt drops below \$40 per barrel, has shown people how dangerous our dependence on foreign oil can be. Though those markets have somewhat stabilized in recent months, it cannot compete with corn and ethanol prices which have remained remarkably steady in comparison. This stability has helped to calm the fears of people who thought there would not be enough ethanol available or that prices would get out of hand. With quieted fears and steady wholesale pricing, ethanol has proven to be very attractive to fuel buyers, even against the cost of diesel.

Despite the warming attitude towards ethanol, Mack admits there are still several challenges ahead. "I think the biggest difficulty lies in education. When AHL-TECH talks about its locomotives, the first thing people ask is how a 'low' BTU value fuel like ethanol can compete with a 'high' BTU fuel like diesel, but they miss the point that four factors are actually involved that make ethanol the right fuel choice. Yes, BTU is one factor, but so are the cost of the fuel itself per gallon, engine efficiency, and finally, the cost of emissions control on the engine. So

while ethanol is a lower BTU fuel than diesel, it is also much lower in cost per gallon," explained Mack. Based on data from the University of Nebraska-Lincoln, AHL-TECH created a new emissions model for its ethanol locomotive engine that shows it can be ten times cleaner in NOx emissions than is required under the Environmental Protection Agency Tier 4 locomotive engine emissions guidelines and can virtually eliminate particulate matter. "We don't need to add costly filters or catalytic reduction systems to do this. That means less cost for the engines and a lower cost of maintenance. It's a win-win-win situation," said Mack.

As work continues on the AHL-TECH project, the CMPM is excited for what the future holds. "With ethanol already utilized in more than 80 percent of the nation's automobile fuel supply, we feel ethanol-powered locomotives are a very promising new ethanol market," stated Clark Gerstacker, CMPM president; National Corn Growers Association Corn Board Member; and corn farmer from Midland. "Since corn is the major feedstock for American ethanol production, AHL-TECH's ethanol-hybrid locomotive may open the door to a new untapped market for Michigan corn. The CMPM is thrilled to be part of this ground-breaking project."

ABOUT THE CMPM

Established under 1965 P.A. 232, and voted in by the state's corn farmers in 1992, the Corn Marketing Program of Michigan receives one penny per bushel for all Michigan corn sold. The "check-off" funding is invested in research, education, market development and new uses. The continuation of the program is voted on by Michigan farmers every five years. For the program to continue, the referendum vote must be approved by both the majority of voting farmers and corn production. The nine-member Board of Directors, appointed by the Governor, sets the yearly direction of the program. As a way to dispense research results to the state's corn farmers, the CMPM annually holds the Corn & Soybean Winter Research Meetings and publishes an Annual Research Report, highlighting current and past check-off funded research projects.



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