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Agronomy Advice

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August 27, 2009 Field Crops 28.4 – 74

Managing Corn to Maximize Ethanol/Biofuel Potential

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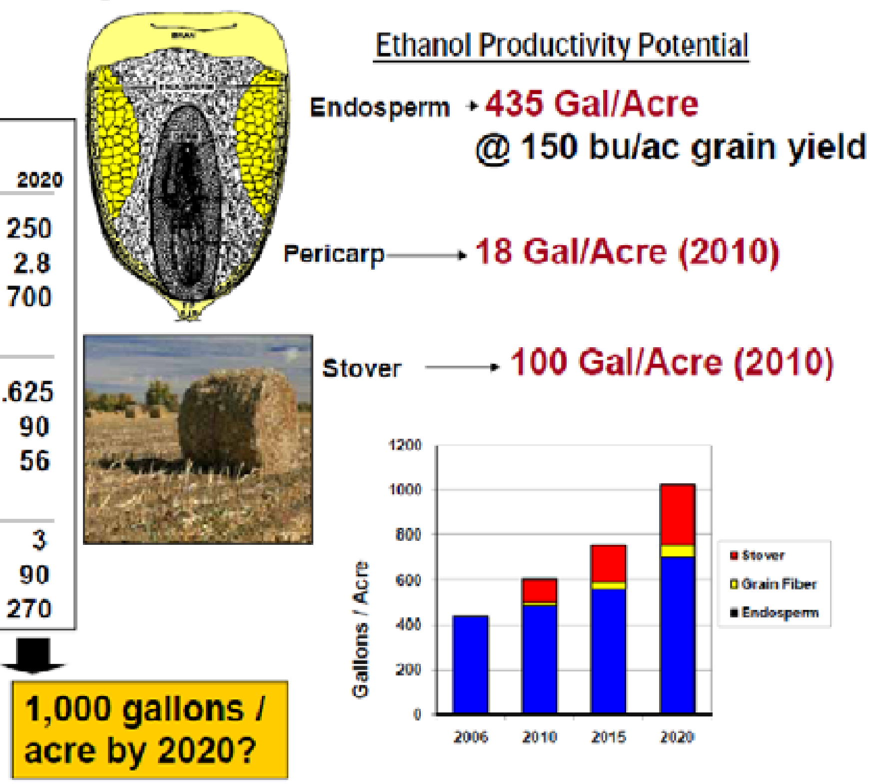
Corn has significant potential as a biofuel (Table 1). The highest potential ethanol yield from grain in Wisconsin has been recorded at 777 gallons/A (Lauer, 2007). The ethanol biofuel industry has dramatically changed corn markets in Wisconsin. Since 2002, nine ethanol plants have been constructed. Two out of five corn rows in a field get processed by an ethanol plant. A small increase in ethanol potential (gallons per bushel) is significant to ethanol plants. For example, a 1% increase in ethanol per bushel increases production of a 50 MG plant about 500,000 gallons ethanol. The objective of this project was to determine the influence of genetics and management on corn ethanol production from corn grain.

Between 2004 and 2008 the management factors of hybrid, plant density, date of planting, row spacing, tillage and rotation were evaluated for grain ethanol production. Ethanol yield (gallons per acre) was closely associated with grain yield, so management practices that improve grain yield will maximize grain ethanol production. Often ethanol potential (gallons per bushel) is statistically significant, but biologically may not be important. The management decision that most influences ethanol potential is hybrid selection (3%). The management decisions of plant density, date of planting, tillage, rotation, and fungicide have little impact on ethanol potential (gallons per bushel).

Future research will concentrate on ethanol production from stover. Our hypothesis is that traits and management practices that improve silage quality for dairy cows will be most beneficial for ethanol production.

Figure 1. Corn Has Significant Potential for Biofuels

Grain Endosperm	2005	2010	2015	2020
Bu/Ac	150	180	200	250
Gal/Bu	2.5	2.7	2.8	2.8
Gal/Ac	390	486	560	700
Grain Pericarp				
Ton/Ac	0	.45	.500	.625
Gal/Ton	0	40	60	90
Gal/Ac	0	18	30	56
Stover				
Ton/Ac	0	2.5	2.75	3
Gal/Ton	0	40	60	90
Gal/Ac	0	100	165	270



Source: Hitz, 2006

Table 1. Theoretical ethanol potential and yield of four commercial hybrids in Wisconsin during 2005 and 2006. Values are means over three replications of four environments (Lorenz et al., 2009)

Corn plant part	Biomass yield		Theoretical ethanol † potential	Theoretical ethanol † yield
	Percent	T DM/A	Gal/DM T	Gal/A
Grain ‡	54	5.28	100	528§
Cob	6	0.57	105	60
Stover	40	3.90	99	384
Total	100	9.76	---	972

† Stover and ear ethanol estimated using the *in vitro* method of Weimer et al. (2005).

‡ Grain ethanol yield = 189 bu/A x 2.8 gal ethanol/bu = 528 gal/A of ethanol.

§ Ethanol yield does not include potential ethanol from the kernel pericarp and tip (0.2 T DM/A * 100 gal ethanol/T = 20 gal/A) and biodiesel produced from the germ (4.3% = 57 gal biodiesel/A assuming 8 lb oil = 1 gal biodiesel). Currently, these products are included in Dried Distiller Grains with Soluables (DDGS) which are approximately 30% of the grain and sold as livestock feed (Applegate et al., 2006).

Corn response to management for ethanol at Arlington, WI during 2008.

Table 2. Hybrid (n= 3 reps).

Relative Maturity	Grain yield	Ethanol	
Days	bu/A	Gal/bu	Gal/A
82	200	2.91	582
84	192	2.87	552
85	214	2.86	612
87	184	2.85	526
90	214	2.87	616
92	190	2.92	554
96	223	2.91	647
97	209	2.90	606
99	236	2.92	691
100	239	2.93	700
104	203	2.87	583
104	258	2.90	750
108	234	2.90	678
108	257	2.89	743
112	237	2.89	686
113	247	2.88	711
LSD(0.10)	25	0.03	76

Table 3. Fungicide (n= 24).

Fungicide	Grain yield	Ethanol	
	bu/A	Gal/bu	Gal/A
Headline SBR	194	2.88	560
Quadris	201	2.89	579
Quilt	199	2.87	572
UTC	191	2.89	553
LSD(0.10)	NS	0.01	NS

Table 4. Plant density (n= 16).

Target density	Plant density	Grain yield	Ethanol	
plants/A	plants/A	bu/A	Gal/bu	Gal/A
14000	14267	176	2.87	505
20000	20928	202	2.85	575
26000	27746	231	2.87	663
32000	33459	236	2.89	681
38000	38983	238	2.90	689
44000	44097	233	2.90	676
50000	49147	233	2.89	676
56000	50315	233	2.90	677
LSD(0.10)	1435	8	0.01	24

Table 5. Planting date (n= 8).

Planting date	Grain yield	Ethanol	
	bu/A	Gal/bu	Gal/A
April 24	214	2.84	608
May 01	220	2.84	624
May 15	226	2.84	643
June 02	179	2.84	510
June 15	130	2.81	364
LSD(0.10)	17	NS	49

Table 6. Tillage (n= 84).

Tillage	Grain Yield	Ethanol	
	bu/A	Gal/bu	Gal/A
Conventional	235	2.93	689
No-Till	213	2.91	620
LSD(0.10)	7	0.01	20

Table 7. Crop rotation (n= 24).

Rotation	Grain yield	Ethanol	
	bu/A	Gal/bu	Gal/A
CC	178	2.88	511
CS	197	2.89	569
CSW	202	2.89	585
CWS	209	2.87	598
LSD(0.10)	NS	0.01	NS

Literature Cited

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