

# **National Corn Growers Association's yield contests of 2006-2009: summary of atrazine versus non-atrazine use**

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## **Abstract**

The National Corn Growers Association (NCGA) sponsors the premier U.S. corn yield contest, which is open to any member of the organization. Entrants compete to maximize corn yields in a variety of agricultural production systems and receive recognition at the state and national levels. Entrants are required to supply specific information such as geographical location, tillage type, herbicide program and harvested bushels per acre. In this analysis, corn yield data from this contest for the years 2006-2009 were grouped into atrazine and non-atrazine herbicide programs to determine the average corn yield for each group, classified by year and by tillage type. The difference in corn yield between programs (i.e., with and without atrazine) was tested for statistical significance using several recognized statistical methods. The average advantage for corn yields from herbicide programs with atrazine was 6.566 bu/acre and is highly significant ( $p < 0.0001$ ), regardless of statistical test method used. Similarly, when data for each group were analyzed by year or by tillage-type classification, there was a positive and statistically significant corn yield advantage (6.351 to 9.089 bu/acre) for all comparisons except year class 2006, where the yield advantage was 4.194 bu/acre and the p-value for the nonparametric methods was 0.0807. The ratio of atrazine herbicide programs to non-atrazine herbicide programs ranged from 2.01:1 to 2.91:1. Across

years, the ratio of unique counties with atrazine entrants to unique counties without atrazine entrants ranged from 1.8:1 to 2.4:1. Analyses of both overall data and data by year and tillage-type classification clearly show that NCGA corn yield contest entries where the herbicide programs included atrazine provided significantly higher corn yield than non-atrazine programs.

## **Acknowledgments**

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### **1. Introduction**

The NCGA National Corn Yield Contest has been an annual event for almost 50 years. In this contest, NCGA members challenge their peers to maximize corn yields. The yield contest web site <http://www.ncga.com/corn-yield-contest> has rules of entry, required data, harvest procedures, yield reporting and other information. For this analysis, data were obtained for 2006 through 2009 from each entry with reported corn yield and subsequently grouped into subsets for analysis. Entries without product-level herbicide use data were not used. The data were grouped according to the NCGA definition for states and tillage type. All herbicide programs were examined to determine if atrazine was used in any form (as single product, or as a component in a premix brand). Data were grouped into the “Yes” (containing atrazine) or “No” (not utilizing atrazine) group. Atrazine content in the herbicide brand was confirmed/denied

using a master herbicide brand list generated from the GfK Kynetec AgroTrak<sup>5</sup> database. Average corn yield across all entries within the chosen subset of the “Yes” and “No” group and the “n” value was determined. The averages are simple-averages of the corn yield data for each entry and are not weighted in any manner. A ratio of the number of entries with atrazine use to non-atrazine use was calculated. Since these data are not direct comparisons of “with” compared to “without” atrazine, this is a measure of grower preference of herbicide selection that, in his or her mind, would maximize corn yield potential under his or her unique set of commercial production conditions. An additional measure of atrazine importance was the geographical distribution among all entrants at the state / county level. Of the total counties within the NCGA corn yield contest, the data can be grouped into “number of unique counties with atrazine-using entrants” and “number of unique counties with non-atrazine entrants.”

## **2. Results**

Corn yield data were summarized and analyzed both overall and by year and tillage-type classifications as reported in Table 1. There were 9,751 entries across years and tillage-group types that could be grouped into herbicide programs that did, or did not, include atrazine, with a ratio of atrazine-use to non-use of 2.32:1. Nearly 70% of entrants included atrazine as a component of their herbicide programs.

The mean difference in corn yield for atrazine and non-atrazine programs was calculated and tested for statistical significance with a Student’s t-test, which assumes normal distribution of error variances for groups, and Wilcoxon Rank-Sums tests (nonparametric methods where the usual analysis of variance assumption of normality is not made). The average corn yield advantage for programs with atrazine compared

to those without was 6.566 bu/acre and is highly significant ( $p < 0.0001$ ) for both statistical test methods. In most statistical analyses, the results are considered significant when the p-value is  $< 0.05$ .

When data were analyzed by year, there was a positive yield advantage (6.532 to 9.089 bu/acre) that was highly significant for year classes 2007, 2008 and 2009. For 2006, when the number of entrants (sample size) was smaller than in other years, the yield advantage was 4.194 bu/acre with a significant t-test p-value of 0.0117 and a p-value for the nonparametric methods of 0.0807.

The effect of tillage type on yield was determined by classifying the seven reduced-tillage systems together and comparing to an “other tillage” class across the four years. For the reduced-tillage class, there were 3,922 entries, with an atrazine-user to non-user ratio of 2.91:1 and an average atrazine yield advantage of 7.542 bu/acre. For the “other tillage” class, there were 5,829 entries with an atrazine-user to non-user ratio of 2.01:1 and a 6.351 bu/acre average yield advantage for atrazine users. In each case, the corn yield advantage for entries with atrazine was highly significant ( $p < 0.0001$ ) for each statistical method.

Analyses of both overall data and data by year and tillage-type classification clearly show that NCGA corn yield contest entries where the herbicide programs included atrazine provided significantly higher corn yield than non-atrazine programs.

A further measurement of the importance of atrazine can be assessed by the geographical distribution of users compared to non-atrazine users in the NCGA corn yield contest (Figure 1). Utilizing the state/county data per entry, the number of unique state/counties with participants in the contest was determined for the atrazine and non-

atrazine users (Table 2). Across the four years, unique contest counties ranged from 492 to 718, where atrazine entrants came from 406 to 602 unique counties compared to 166 to 308 counties with non-atrazine entrants. The prevalence of atrazine users is across the corn-growing area of the United States. The distribution of counties with atrazine users in the contest across the four years can be seen in the attached map where each “pin” represents a county. Across the four years, there were 1,042 unique counties with entrants in the yield contest.

From the above analyses, it is clear why growers choose an herbicide program containing the economical and proven product atrazine to maximize corn yields.

Figure 1: Counties with Corn/Atrazine in 2006-2009 – Doane AgServe/NCGA



**Table 1: National Corn Growers Yield Contests 2006-2009.  
Comparison of Herbicide Programs With vs Without Atrazine.**

Variable	N Value Of Data Set	Ratio of Atrazine To Non Atrazine Users	Number Of Bushels Advantage With Atrazine	Statistical Test Probabilities <sup>1</sup>		
				t-Test <sup>2</sup> Prob > t	Rank-Sums Normal Approx. <sup>3</sup> Prob >  Z	Rank-Sums Chi- square Approx. <sup>4</sup> Prob > ChiSq
All Data	9,751	2.32:1	6.566	<.0001	<.0001	<.0001
2006 All Data	1,619	2.65:1	4.194	0.0117	0.0807	0.0807
2007 All Data	2,233	2.46:1	9.089	<.0001	<.0001	<.0001
2008 All Data	3,032	2.29:1	7.073	<.0001	<.0001	<.0001
2009 All Data	2,866	2.09:1	6.532	<.0001	<.0001	<.0001
All Reduced Tillage Classes*	3,922	2.91:1	7.542	<.0001	<.0001	<.0001
Other Tillage Classes **	5,829	2.01:1	6.351	<.0001	<.0001	<.0001

State Groupings: "AA" entries from states of IA, IL, IN, OH, MN, MO, and WI. "A" entries from all other states.

\*Classes combined: "A" No/Strip Till No Irrigation, "A" Ridge Till No Irrigation, "AA" No/Strip Till No Irrigation, "AA" Ridge Till No Irrigation, No/Strip Till Irrigated, Ridge Till Irrigated and Ridge Till No Irrigation.

\*\* Other Tillage Classes: "A" No Irrigation, "AA" No Irrigation, and Irrigated.

<sup>1</sup> Values < 0.05 are considered statistically significant.

<sup>2</sup> Student's t-test (assumes normal distribution of error variances for groups)

<sup>3</sup> Wilcoxon rank-sums two-sample test with normal approximation (nonparametric method; no assumption of normality)

<sup>4</sup> Wilcoxon rank-sums one-way test with chi-square approximation (nonparametric method; no assumption of normality)

**Table 2: National Corn Growers Yield Contest: 2006-2009 Summary Statistics**

	<b>2006</b>	<b>2007</b>	<b>2008</b>	<b>2009</b>	<b>4-Year Total (Unduplicated counties)</b>
<b># US Corn Growing Counties from Doane AgServe<sup>5</sup></b>	2,614	2,627	2,632	2,623	<b>2,744</b>
<b>Unique Counties Reporting Yield</b>	492	617	718	625	<b>1,042</b>
<b># Entries of Herbicide Programs w/Atrazine</b>	1,175	1,587	2,109	1,928	
<b># Unique Counties w/Atrazine</b>	406	522	602	504	<b>931</b>
<b># Entries Herbicide Programs w/o Atrazine</b>	444	641	924	908	
<b># Unique Counties w/o Atrazine</b>	166	233	308	279	<b>525</b>
<b>Ratio of Counties w/Atrazine to Counties w/o Atrazine</b>	2.4:1	2.2:1	1.9:1	1.8:1	

<sup>5</sup>GfK Kynetec/Doane AgServe, AgroTrak