

**Ag BioTech Info Net Technical Paper Number 3
May 2000**

***Prevalence of Genetically Modified Traits in the
Corn and Soybean Varieties Offered to
Midwestern Farmers in Crop Year 2000***

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INTRODUCTION

Over the last five years a growing share of seed industry R+D and breeding effort has focused on the incorporation of herbicide tolerant and *Bt*-transgenic traits into major agronomic crops, especially corn and soybeans. Several concerns¹ stemming from the planting of such GMO varieties have become part of the global debate on agricultural biotechnology –

- Might seed-pesticide companies nudge farmers toward the purchase of certain products by limiting the supply of the best genetics for a given region and soil type?
- Will a narrowing of the genetic base of major crops heighten vulnerability to unexpected yield losses?
- Will heavy reliance on a few herbicides, especially Monsanto's Roundup (glyphosate) trigger the emergence of resistance and shifts in weed populations?
- Will *Bt*-corn lead to resistance or adverse impacts on beneficials or non-target Lepidopteran species like the Monarch butterfly?
- Will the supply of GMO corn and soybeans trigger marketing problems and a softening of prices as a result?

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¹ For information on resistance to *Bt* in transgenic corn varieties, see several reports and sources of information at <<http://www.biotech-info.net/bt-transgenics.html#ECB>>. Information on *Bt*-impacts on Monarch butterflies is accessible at <http://www.biotech-info.net/butterflies_btcorn.html>. Extensive information on Roundup Ready soybeans and other crops is at <<http://www.biotech-info.net/herbicide-tolerance.html#soy>>. See other sections of Ag BioTech InfoNet <<http://www.biotech-info.net/>> for further information on other impacts of GMOs.

The acreage planted to herbicide tolerant soybeans and *Bt*-corn grew rapidly through the 1999 crop season, which may well emerge as the high-water mark for market penetration of these varieties. Several surveys and projections on planting intentions in crop year 2000 have been released in the last several weeks, all pointing to a reduction in the acreage planted to genetically enhanced varieties. *Bt*-corn acreage is likely to fall about 25 percent and the acreage of Roundup Ready beans is expected to slip 5 to 10 percent.

Most surveys point to three major causes for this turn of events --

- The relatively high cost and poor economic return from the investment in these varieties for some farmers.
- Uncertainty in the marketplace and fear of discounts come harvest-time.
- Farmer awareness of the potential adverse impacts of the technologies, the cost of adhering to recommended resistance management plans, and the implications of the technology agreements that must be signed when purchasing seed.

One thing is clear from the data presented in this short report – the supply of GMO seeds is not among the concerns leading to a reduction of the acreage devoted to these varieties. We reach this judgement despite a caveat -- Information is not available, and indeed is closely guarded by all companies, on the quantity of seed produced and offered for sale in each state by variety and relative maturity group.

Based on a series of discussions with seed industry leaders and analysts, we think it is generally safe to assume that the companies have produced relatively significant quantities of most new and featured varieties. There will be exceptions of course – for example, a Roundup Ready soybean variety in a long-season maturity group offered for sale in Wisconsin or another state at the northern edge of the zone where long-season soybeans are grown. From past experience, companies would know the market for such a variety is small and would plan accordingly to cut back the amount of seed produced.

Likewise, we have heard anecdotal reports that some companies are offering limited quantities of older, conventional varieties in several states because of the sharp decline in demand for them over the last four years. For these reasons, the local availability of non-GMO varieties is probably more limited than these data suggest, especially given the shift in market demand after the spring of 1999, the point in time when seed companies had to allocate most of their seed production fields to various varieties.

METHODOLOGY

To their credit, seed companies responded in 1999 to requests from growers, crop consultants, researchers and others for more complete information on their websites regarding the characteristics and genetics of the different varieties offered for sale. We assessed all corn and soybean varieties offered by Pioneer Hi-Brid and DeKalb Seed companies in major Midwestern states – Iowa, Illinois, Missouri, Minnesota and

Wisconsin. Varieties offered by Garst were also assessed, although just for the nation as a whole since Garst does not offer varietal recommendations by state. In the case of soybeans, we also assessed the varieties offered by the Stine seed company. (See References for website site addresses of each company).

In the case of corn hybrids, we counted the number of varieties offered in up to three relative maturity groups – early season, mid and full season. Essentially identical criteria are used by all seed companies in assigning hybrids to maturity groups. We counted the number of hybrids containing a GMO trait, the number of non-engineered varieties, and expressed the number of GMO varieties as a percent of the total number offered by relative maturity group. We also focused on the traits the seed companies are featuring in their “new for year 2000” varieties.

In the case of corn, we counted the number of hybrids by company and relative maturity group expressing *Bt*-proteins, as well as the number of hybrids that are herbicide tolerant and the number of new GMO and non-GMO varieties. In soybeans we also assessed “new for 2000” traits and the number of varieties engineered to tolerate Roundup herbicide in contrast to all other herbicides.

FINDINGS

Table 1 summarizes the corn hybrid varieties available by relative maturity group. With a few exceptions mostly in the early maturity group, GMO varieties make up a third to over one-half the varieties offered.

In some states and maturity groups, GMO hybrids account for two-thirds or more of the varietal offerings. Clearly, farmers in Iowa wanting to grow a full season Pioneer hybrid will have relatively few non-GMO varieties to choose from; GMO traits are included in 83 percent of the full season hybrids offered.

Across the board, the percent of DeKalb hybrids containing GMO traits is half or less than the percent of Pioneer hybrids offered for sale in the same state and maturity group.

Table 2 presents comparable data on soybeans. In most states and maturity groups, farmers have about an equal number of conventional and GMO varieties to choose from, although there are exceptions. In two cases, Pioneer Hi-Brid offers a single GMO variety in the longest maturity group offered in a state. As in the case with corn, Pioneer soybean varieties in the heart of the Cornbelt – Iowa and Illinois – are much more likely to be herbicide tolerant than DeKalb varieties. Garst varieties track closely those from Pioneer in prevalence of GMO traits.

Table 1: Corn Hybrids Available By Company, Crop Year 2000

Company: State Relative Maturity*	Non-GMO	GMO	Total	GMO as % of Total
DeKalb: Iowa				
Early	32	5	37	14%
Mid	23	9	32	28%
Full	17	3	20	15%
DeKalb: Illinois				
Early	6	0	6	0%
Mid	21	8	29	28%
Full	17	3	20	15%
DeKalb: Missouri				
Early	5	3	8	38%
Mid	16	8	24	33%
Full	17	0	17	0%
DeKalb: Minnesota				
Early	31	5	36	14%
Mid	21	9	30	30%
DeKalb: Wisconsin				
Early	31	5	36	14%
Mid	21	9	30	30%
Garst: National				
Early	23	8	31	26%
Mid	21	22	43	51%
Full	12	10	22	45%
Pioneer: Iowa				
Early	7	8	15	53%
Mid	9	9	18	50%
Full	2	10	12	83%
Pioneer: Illinois				
Early	1	1	2	50%
Mid	4	6	10	60%
Full	3	7	10	70%
Pioneer: Missouri				
Early	1	1	2	50%
Mid	8	5	13	38%
Full	4	8	12	67%
Pioneer: Minnesota				
Early	21	12	33	36%
Mid	4	4	8	50%
Pioneer: Wisconsin				
Early	28	14	42	33%
Mid	8	10	18	56%
Full	1	1	2	50%

*Relative Maturity Group corresponds to the number of degree days required for the plant to mature. Early varieties are for cooler regions with a shorter growing season; Full varieties for regions with long seasons and more intense heat.

Source: Benbrook Consulting Services, based on information from seed company websites (see references).

Table 2: Soybean Varieties Available by Company, Crop Year 2000

Company: State	Non-GMO	GMO	Total	GMO as % of Total
Relative Maturity*				
DeKalb: Iowa				
Group O	4	1	5	20%
Group I	6	3	9	33%
Group II	8	3	11	27%
Group III	7	8	15	53%
Group IV	5	7	12	58%
DeKalb: Illinois				
Group II	4	2	6	33%
Group III	7	7	14	50%
Group IV	5	7	12	58%
DeKalb: Minnesota				
Group O	4	1	5	20%
Group I	6	3	9	33%
Group II	8	3	11	27%
Group III	4	1	5	20%
DeKalb: Missouri				
Group II	4	2	6	33%
Group III	7	7	14	50%
Group IV	5	7	12	58%
DeKalb: Wisconsin				
Group O	4	1	5	20%
Group I	6	3	9	33%
Group II	8	3	11	27%
Group III	4	1	5	20%
Garst: National				
Group O	2	5	7	71%
Group I	6	5	11	45%
Group II	7	7	14	50%
Group III	8	9	17	53%
Group IV	4	7	11	64%
Group V	0	1	1	100%
Pioneer: Iowa				
Group I	2	3	5	60%
Group II	9	6	15	40%
Group III	7	11	18	61%
Group IV	0	1	1	100%
Pioneer: Illinois				
Group I	1	1	2	50%
Group II	3	4	7	57%
Group III	5	7	12	58%
Group IV	2	2	4	50%
Group V	1	1	2	50%
Pioneer: Minnesota				
Group O	6	3	9	33%
Group I	4	5	9	56%
Group II	4	3	7	43%
Pioneer: Wisconsin				
Group O	3	3	6	50%
Group I	5	4	9	44%
Group II	7	5	12	42%

*Relative Maturity Group corresponds to the number of degree days required for the plant to mature. Group O varieties are for cooler regions with a shorter growing season; Group V for regions with long seasons and more intense heat.

Source: Benbrook Consulting Services, based on information from seed company websites (see references).

Company: Region	Number of Varieties					Number of GMO Traits		
	Total	New	New GMO	GMO	Non-GMO	Total	Bt-Insect Tolerant	Herbicide Tolerant
DeKalb: Iowa	88	11	1	11	77	17	14	3
DK: Illinois	49	6	0	11	38	11	9	2
DK: Minnesota	66	9	1	14	52	14	12	2
DK: Missouri	49	6	0	11	38	11	9	2
DK: Wisconsin	66	9	1	14	52	14	12	2
Totals*	318	41	3	61	257	67	56	11
As % of Total		13%	1%	19%	81%		84%	16%
Garst: National	99	28	18	40	59	50	13	37
As % of Total		28%	18%	40%	60%		26%	74%
Pioneer: Iowa	45	25	17	25	20	29	21	8
P: Illinois	22	18	12	14	8	15	12	3
P: Minnesota	41	18	11	16	25	16	14	2
P: Missouri	27	12	8	14	13	16	10	6
P: Wisconsin	62	20	12	25	37	27	18	9
Totals*	197	93	60	94	103	103	75	28
As % of Total		47%	30%	48%	52%		73%	27%
Stine: National	33	15	9	10	23	13	9	4
As % of Total		45%	27%	30%	70%		69%	31%
* Total number of varieties offered in all areas; several varieties are offered in multiple areas, so these totals do not correspond to the number of unique varieties marketed by company.								
Source: Benbrook Consulting Services, based on information from seed company websites (see references).								

The number of new varieties and nature of GMO traits are summarized for corn hybrids in Table 3 and for soybeans in Table 4. About two-thirds of the new corn hybrids introduced by Pioneer, Garst and Stine in crop year 2000 contained GMO traits. DeKalb, on the other hand, introduced only three new GMO corn hybrids in crop year 2000, about 7 percent of its new offerings. As expected, the *Bt*-gene accounts for the majority of the GMO traits in corn: 84 percent in the case of DeKalb hybrids, 73 percent with Pioneer's, and 69 percent in the case of Stine. Only Garst bucks the trend, with about three-quarters of its GMO traits conferring herbicide tolerance and about one-quarter expressing the *Bt* proteins.

Table 4. Soybean Seed Varieties Offered by Major Seed Companies, Crop Year 2000

Company: Region	Number of Varieties					Number of GMO Traits		
	Total	New	New GMO	GMO	Non-GMO	Total	RR Herbicide Tolerant	Other Herbicide Tolerant
DeKalb: Iowa	52	20	14	22	30	22	20	2
DK: Illinois	32	10	8	15	17	15	13	2
DK: Minnesota	30	13	7	8	22	8	8	0
DK: Missouri	32	10	8	16	16	16	14	2
DK: Wisconsin	30	13	7	8	22	8	8	0
Totals*	176	66	44	69	107	69	63	6
As % of Total		38%	25%	39%	61%		91%	9%
Garst: National	61	19	16	34	27	34	29	5
As % of Total		31%	26%	56%	44%		85%	15%
Pioneer: Iowa	39	9	7	21	18	21	17	4
P: Illinois	25	6	4	14	11	14	12	2
P: Minnesota	25	3	1	11	14	11	11	0
P: Missouri	22	7	5	15	7	15	12	3
P: Wisconsin	27	4	2	12	15	12	12	0
Totals*	138	29	19	73	65	73	64	9
As % of Total		21%	14%	53%	47%		88%	12%
Stine: National	76	43	25	31	45	31	28	3
As % of Total		57%	33%	41%	59%		90%	10%

* Total number of varieties offered in all areas; several varieties are offered in multiple areas, so these totals do not correspond to the number of unique varieties marketed by company.

Source: Benbrook Consulting Services, based on information from seed company websites (see references).

Incorporating Roundup resistance in soybeans clearly dominated the focus of seed companies in preparation for the year 2000 crop season. Over 90 percent of the GMO traits in soybean varieties surveyed involved tolerance to Roundup. Companies offered growers many new varieties – 57 percent of Stine’s total soybean varieties were new for crop year 2000; Pioneer’s offerings changed less dramatically, with new varieties accounting for 21 percent of the total offered.

Again, about two-thirds of the new varieties offered by all the companies were Roundup Ready, evidence of the dominant impact this technology has had on soybean breeding priorities in the last few years.

CONCLUSIONS

These data confirm that major U.S. seed companies remained heavily focused on the introduction and marketing of GMO corn and soybean varieties in crop year 2000. In some states and relative maturity groups, the choice of genetics offered to farmers has narrowed appreciably, especially for those wishing to plant traditional varieties. The economic consequences of this trend are bound to be significant and are described in the paper “World Food System Challenges and Opportunities: GMOs, Biodiversity, and

Lessons from America's Heartland," (accessible at <http://www.biotech-info.net/IWFS.pdf>).

Because of volatility in the marketplace, policy-arena, and changes in product performance, seed companies continue to face a difficult challenge in planning their production so that the supply of conventional and GMO seed matches demand. The need to balance and manage more complex inventories, and guard against shortages and dispose of periodic oversupplies may well increase the long-run cost of seed and could divert seed industry resources from overcoming physiological and environmental constraints to yield.

References

DeKalb Seed Company variety information is from the "Seed Resource Guide 2000" accessible at <http://www.dekalb.com/seed2k/ProductQuery1.asp/>

Garst seed varieties are described at <http://www.garstseed.com/>

Pioneer Hi-Bred varieties are described at <http://www.pioneer.com/usa.index.htm/>
Information in this report was derived from the corn and soybean characteristics ratings tables presented by state.

Stine soybean seed varieties are described at <http://www.stine.com/soybeans.htm> and corn varieties at <http://www.stine.com/corn.htm>