AgBioForum – Volume 2, Number 2 – 1999 – Pages 118-125

TRAIT ENTHUSIASM DOES NOT GUARANTEE ON-FARM PROFITS

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Adoption of agronomic traits has led to investment into quality traits. However, true values of these traits are poorly understood. Traits may lack the required value to satisfy all participants in the chain from technology supplier to end user. There are no guarantees, under current conditions producers will benefit.

Key words: agribusiness, agronomic traits, biotechnology, input traits, life sciences, producer value, output traits, quality traits.

Monsanto Chief Executive Officer (CEO), Robert Shapiro, and Cargill Agricultural Division President, Fritz Corrigan, have both predicted that within a decade a quarter of all grain production will be devoted to quality or output traits. The secretary-general of the International Seeds Trade Federation has estimated that the market for genetically altered seeds, both input and quality traits, will reach a value of $20 billion by 2010.

Among quality trait missionaries enthusiasm runs high. Much of this is due to the confidence that biotechnology will yield highly desirable quality traits for feed, food, pharmaceutical, and industrial uses. The agricultural sector is still reveling in the success of agronomic, also known as input, traits. The vision created by the rapid adoption of *Bacillus thuringiensis* (Bt) corn and Roundup Ready soybeans moves trait providers to pursue other trait-related opportunities, such as high and better oil content, reduced anti-nutritionals and industrially-related products.

At the same time, the more mature agribusiness sector is evolving into the less mature life sciences sector. Executive visionaries committed to life science are challenged to explore new uses for their technology and expand their grower base. Quality traits are the apparent next step in the biotechnology revolution, and stockholders of evolving life science companies are banking on the ongoing success of agronomic traits and future success of quality traits.

While executives and stockholders are forecasting their profits, producers are also stepping up and asking how a trait-oriented world will impact their future on the farm. Some CEOs predict that more specialized crops for specific uses will result in improved profitability on the farm. We in the consulting world tend to be more conservative as to the on-farm opportunity.

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Table 1. Quality Or Output Traits For Corn And Soybeans.

Corn Traits		
Feed Manufacturing	**Food Processing**	**Estimated Year of Introduction**
–	High Amylose	1970s
–	Waxy	1970s
Nutritionally Enhanced	–	1980s
High Oil	–	1994
High Oleic	–	1999
High Lysine	–	2000
High Available Phosphorus	–	2000
High Methionine	–	2003
High Threonine	–	2005
High Tryptophan	–	2005
Soybean Trait		
Feed Manufacturing	**Food Processing**	**Estimated Year of Introduction**
High Methionine	–	Unknown
Trypsin Inhibitor Free	–	Unknown
–	High Palmitic	Unknown
–	High Stearic	Unknown
–	Reduced Goitrogens	Unknown
–	High Oleic	1997
–	Low Saturated Fat	1997
–	High Sucrose	1997
–	Elimination of the Lipoxygenase Enzyme	1997 (see high sucrose)
–	Low Linolenic	1998
Low Oligosaccharide	–	2001
High Lysine	–	2003

A Corn And Soybean Example: The Food And Feed Trait Pipeline And Seed Cost

There are numerous quality traits that are, or could be, available for corn and soybeans, as can be seen in table 1. Similar quality trait efforts are also underway in canola, sunflowers, wheat, rice, and other crops. Not all of these traits can be commercialized with success. For example, high palmitic acid soybeans will not be commercialized on a broad scale, if at all, because the trait offers no apparent consumer value and would only be used in niche markets. However, high oil corn which offers additional feeding value has been adopted both as a contract crop and for on-farm feed use.

To complicate this picture, let us consider the many agronomic traits that are in the market (see table 2) and consider stacking options. It is highly likely that quality traits will be stacked with other quality traits, and quality traits will also be stacked with agronomic traits. This creates numerous possibilities for seed characteristics as herbicide, insect, and disease tolerances are combined with quality traits, but this all comes at a seed cost for the producer.

Table 2. Agronomic Or Input Traits.

Corn Traits	**Estimated Year Of Introduction**
IMI	1991
Bt	1996
SU	1996
Liberty Tolerant	1997
Roundup Tolerant	1998
Corn Root Worm	2001
Disease Resistant	2003
Soybean Trait	**Estimated Year of Introduction**
STS	1993
Roundup Tolerant	1996
Liberty Tolerant	1999

<u>A Hypothetical Case</u>

Let us take the example of a hypothetical "Bt, herbicide tolerant, high oil, high lysine, and low phytate " hybrid (see table 3). There are no overlapping traits, just stacking. A high quality feed hybrid with insect and weed control would certainly seem attractive. But, let us look at the potential cost of a bag of seed.

Of course, seed cost in table 3 is purely guess work. The Bt traits vary in their cost depending on level of European corn borer (ECB) control, herbicide tolerance costs vary, and the true values of traits in the pipeline are unknown. But this seed cost story does illustrate the challenge companies will face when determining the value of their seed and the potential cost of genetics, which is the key to producer adoption.

At a $30.00 to $132.00 range, a producer would have to recover $10.00 - $44.00 per acre (assuming one unit plants three acres) to compete with traditional corn. This includes a range of $0 - $42 per unit ($0 - $14 per acre) for agronomic traits and $30 - $90 per unit ($10 - $30 per acre) for quality traits.

Table 3. Seed Cost Per Unit Of Hypothetical Hybrid.

Trait	**Premium Or Fee**	**$/unit**	**$/acre (1 unit/3 acres)**
Bt	Seed Premium	0.00 - 24.00	0.00 - $8.00
Herbicide tolerant	Technology Fee	0.00 - 18.00	0.00 - $6.00
High Oil	Seed Premium	10.00 - 30.00	3.33 - $10.00
Low Phytate	Seed Premium	10.00 - 30.00	3.33 - $10.00
High Lysine	Seed Premium	10.00 - 30.00	3.33 - $10.00
TOTAL COST		**30.00 - 132.00**	**10.00 - 44.00**
+ Elite Genetics		**96.00**	**32.00**
TOTAL UNIT COST		**126.00 - 228.00**	**42.00 - 76.00**
Cost for agronomic traits		**0.00 - 42.00**	**0.00 - 14.00**
Cost for quality traits		**30.00 - 90.00**	**10.00 - 30.00**

<u>Valuing Quality Traits</u>

A quick review of this hypothetical product:

- **High oil corn** is desirable to poultry and swine feeders for its improved metabolizable energy that results from higher oil and protein content. In addition, high oil corn also offers an improved fatty acid profile. Typically, high oil corn replaces fat for energy in feed rations. Using least cost feed formulation models, commonly used by feeders, Context Consulting estimates the current value of high oil corn at $0.25 - $0.30 per bushel as a fat replacer.

- **High lysine corn** provides a substitute product for synthetic lysine, which is produced through a fermentation process. Lysine is a necessary amino acid for poultry and swine feeders. Context Consulting least cost feed formulation models place the value of high lysine corn at $0.05 - $0.12 per bushel as a replacement for synthetic lysine.

- **Low phytate corn** will be used as a replacement for other phosphorus sources. Phosphorus is an essential nutrient in animal feed. The problem lies in controlling the volume of phosphorus escaping through manure into waste, which is an environmental concern. Low phytate corn produces grain with a significant and beneficial alteration in the ratio of phytate-bound phosphorus to inorganic phosphorus. This improved ratio of available to unavailable phosphorus for swine and poultry feed offers advantages in the form of a more nutrient dense grain and more flexibility in ration formulation. The environmental advantage is that less phosphorus is excreted in the manure. As a substitute product for other phosphorus sources, Context estimates place the value of low phytate corn at $0.04-$0.07 cents per bushel. At this time, environmental value is not measured.

Given the above assumptions, we find that the *quality trait value* of our hypothetical "Bt, herbicide tolerant, high oil, high lysine, and low phytate" hybrid falls between $0.34 - $0.49 per bushel.

High oil	$0.25 - $0.30
High lysine	$0.05 - $0.12
Low phytate	$0.04 - $0.07

Total value	$0.34 - $0.49

This sounds attractive, but the cost for quality traits is estimated at $10.00 - $30.00 per acre and it must be recouped.

We soon discover that significant premiums are required at the grower level to simply break even with the cost of quality traits in the seed (table 4). In addition, estimated costs for identity preservation, not including grower premiums, are $0.10 - $0.30 per bushel. In the best case scenario, this leaves $0.24 - $0.39 per bushel in the system to satisfy growers and end users. Just $0.04 - $0.19 is left for growers and end users in the worst case scenario (where the cost of identity preservation comes in at the high-end). It is unlikely that growers will receive the bulk of this value. As shown in table 4, grower premiums to break even with the cost of quality traits in the seed can quickly absorb any additional value. Hence, when grower premiums and costs of identity preservation are their lowest end user value ranges from $0.18 - $0.33 per bushel (see table 5). However, if grower premiums and costs of identity preservation come in at the high-end then end user value may be negative, or at best zero. These ranges are based on break even premiums for growers. Costs of agronomic traits and additional profits for the producer have yet to be included.

Table 4. Premiums Required To Recoup Costs Of Quality Traits.

Yield (bu/ac)	Premium/bu required at $10/ac quality trait seed cost	Premium/bu required at $30/ac quality seed cost
160	$0.06	$0.19
180	$0.06	$0.17
200	$0.05	$0.15
220	$0.05	$0.14

Table 5. Quality Trait Summary

Quality Trait	Value ($/bu)
• High Oil Corn	$0.25 - $0.30
• High Lysine Corn	$0.05 - $0.12
• Low Phytate Corn	$0.04 - $0.07
Total	$0.34 - $0.49
Less Cost of Identity Preservation	$0.10 - $0.30
Remaining Value for Growers & End Users:	
• Best Case	$0.24 - $0.39
• Worst Case	$0.04 - $0.19
Less Grower Premiums for Breakeven (160 bu/ac)	$0.06 - $0.19
Value Left for End User	
• Best Case	$0.18 - $0.33
• Worst Case	- $0.15 - $0.00

Valuing Quality Traits

As mentioned earlier, the cost of agronomic traits has yet to be included in this discussion. A producer may believe the Bt trait is needed to protect quality grain yields from ECB infestation; however, in 1998 ECB pressure was extremely low and some Bt hybrids with the superior trait offered only a two bushel per acre yield advantage over their non-Bt counterparts. Commodity corn prices fell to $1.80 and below. The result was a $10 per acre cost for the superior Bt trait, but only a $3.60 per acre advantage. The Bt trait obviously provided no economic advantage for some producers. However, in other years producers saw tremendous yield advantages with the superior Bt trait. Using an eight bushel per acre yield advantage and $2.20 per bushel corn, producers receive an additional $17.60/acre, or $7.60/acre over the technology fee cost.

For herbicide tolerant corn, the cost of traits and the reduced cost of alternative herbicide programs determine the value. Value of herbicide tolerant technologies will change with herbicide costs, weed problems, and hybrid performance. In short, the producer value for agronomic traits is a moving target and only historical data can measure the importance of some traits as insurance.

Other Issues

In evaluating the future, we must remember that producers involved in quality traits have primarily relied on contracting. These contracts, typically with grain merchandisers or processors, come with incentives and penalties for grain quality. Many academics and rural groups fear contracting will lead to a reduction of producer independence. Others argue that biotechnology and the availability of trait-specific products can provide incremental benefits to the producer.

Yield drag is another issue faced by producers and input suppliers. The "Bt, herbicide tolerant, high oil, high lysine, and low phytate" hybrid example assumes no yield drag, yet it is often assumed on the producer level that characteristics associated with quality traits may adversely affect the yield. Other conditions, such as the type of germplasm and anti-nutritional factors, also influence the yield. Yield drag can also come in the form of a wider range of yields, or variability. Yield drag can be caused by physiological factors; for example, in the case of starch, modifications of starch content or structure, by definition, vary with yield. Yield drag can be more nebulous in the case of genetic modification, where inserting traits into varieties, coupled with the fast transition to better performing varieties, often means that genetic output modifications are several generations behind the best germplasm for yield, vigor, and consistency.

As for identity preservation costs, some large grain handlers have said there are no additional costs to the storage and transportation system if sufficient quantities are available. If large merchandisers desire to play in the market, they can do it without incurring additional costs. This would be accomplished through on-farm storage, which is a critical point to the identity preservation discussion. Given that volumes of quality traits will be much lower than traditional grain, it is difficult for a large handling facility to maintain segregation. However, smaller, on-farm storage provides the needed segregation capabilities and this comes at an additional cost for the producer.

It is unlikely that any quality traits will be introduced to areas without on-farm storage capabilities, unless an adequate country elevator system is available "near farm". It is also important to note that the grain handler perspective of reducing identity preservation costs is actually a shift of costs from the handler to the producer. Costs still remain within the system.

<u>Another View</u>

Interestingly, there are predictions that producers may actually gain power as life science companies compete for acreage. Areas with historically consistent growing conditions, or specific agronomic characteristics, may become desirable contract areas for companies attempting to reduce risks. Producers in these key locales may find that acreage competition will prove profitable on the farm as premiums are used to compete for the best growers.

Some producers have begun to discuss how historical data generated by tools of precision agriculture may allow for the creation of "production resumes" that can be used to gain access to desirable crops. These production resumes would be used in negotiations with contracting firms for specific fields. Perhaps a premium system would not be needed and the contracting firm would simply pay a flat rate for the acreage.

Of course, there are obvious flaws with both concepts, but the idea of a shift in bargaining power for the producer is interesting.

The Moral Of The Story -- No Sure Thing

The agricultural landscape will become increasingly complicated with tailored quality and agronomic trait products. Value to the producer will have to be carefully understood based on seed price, historical benefit of agronomic traits, and available premiums for quality traits. Producer premiums will reflect only a small piece of the total value that has to be shared throughout the value chain from genetics supplier to the end user.

The total value of a quality trait will also be a moving target. The "Bt, herbicide tolerant, high oil, high lysine, and low phytate" example used in this discussion was based on the value of such a product as a substitute for current animal feed inputs. Yet, there may be carcass quality value that results from a tailored product and environmental value that has not been considered. In addition, competitive response from existing feed input suppliers can drive any current value down as they attempt to maintain their industries. This will naturally affect any potential for interested producers.

The moral of this story is complex. Both agronomic and quality traits may offer opportunities for the producer, but there is no sure thing in this changing environment.