

VARIETY APPROVAL STANDARDS AND GROWER PRODUCTION OVER RECENT YEARS

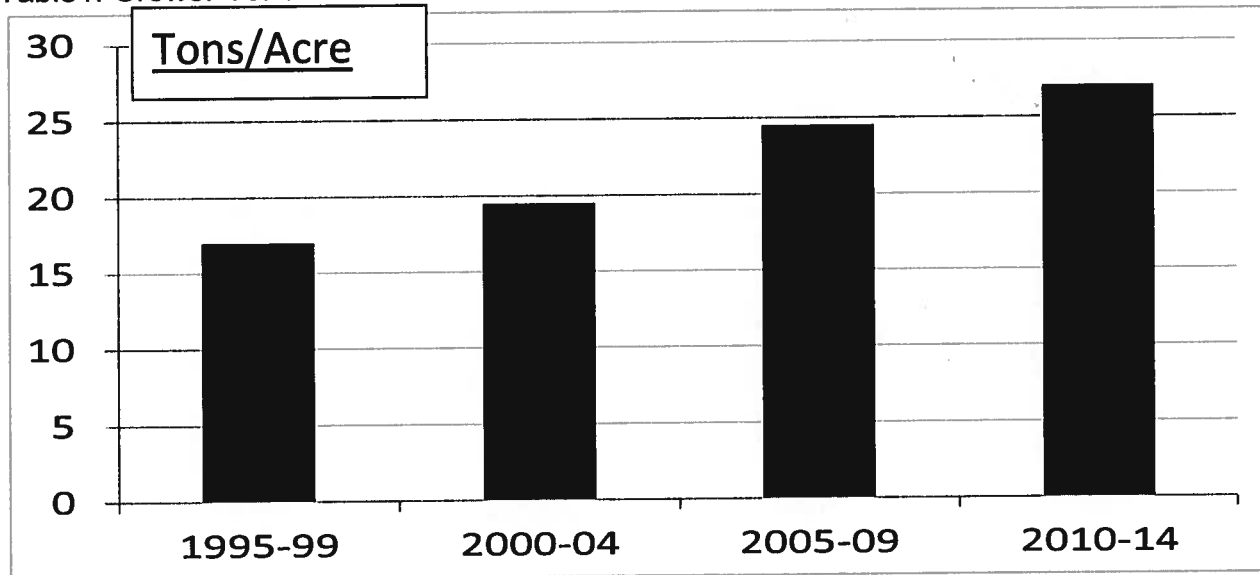
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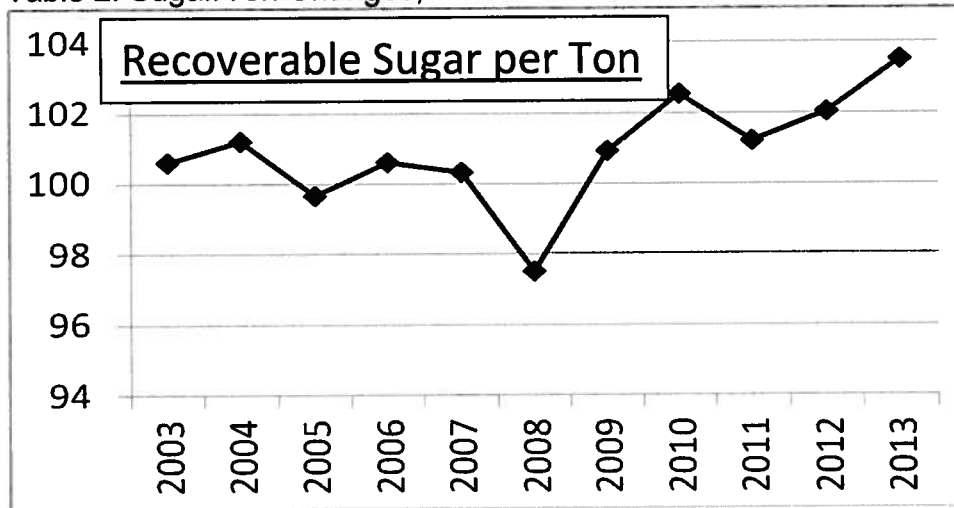
The varieties have a large influence on grower production and profit. Grower production for Michigan Sugar Company has increased in recent years. There were large increases in tons/acre and good increases in sucrose/ton and purity. Table 1 shows the increase in grower tons/acre. There has been a 10 ton/acre increase over 15 years. Comparing five year averages for purity, the increase from 2000-2004 to the 2005-2009 was more than 1.5% and there was a 2% increase by 2010-2014. The percent sucrose did increase over years but was affected more by planting date and rainfall each year. Because of the yearly effect of growing conditions a better way to compare percent sucrose and Recoverable Sugar per Ton (RST) would be comparing the most commonly planted varieties. Using data from our Official Variety Trials the RST in the commonly planted varieties is higher in recent years (Table 2).

Table1. Grower Tons/Acre



There are many traits to make an ideal variety and there is no variety that has all the traits we would like. Michigan Sugar Company has requirements a variety must meet to be approved to sell to their growers. Improving production and resistance traits through breeding is a slow process. Two things we have learned; the seed companies will breed for the requirements set for variety approval and because of the slow breeding process there is a huge advantage to make approval requirement changes years in advance.

Table 2. Sugar/Ton Changes, Percent of Check Varieties



Our approval requirement levels are in Table 3 for recent years. The Recoverable Sugar per Acre (RSA) requirement had large increases, from 80.9% to 92.4% for 2015, but still did not keep up with the larger increases in production of approved varieties, being only 92.4% for 2015-2019. Some current varieties that meet approval have lower RSA reinforcing the fact that the seed companies will breed for the approval requirements. We have many varieties that are over 100% for RSA but the requirement for 2014 was only 88.2% of the check varieties. We do not want to loose in tons per acre is why the requirement for RSA is increasing 10% by 2020.

Table 3. Variety Approval Requirement Levels in % of Check Varieties

Varieties first tested in:	Before 2008	2008-2009	2010-2014	2015-2019	2020
RSA	80.9%	83.5%	88.2%	92.4%	98.2% or more
RST	96.8%	97.7%	99.0%	101.9%	102.7% or more
Cercospora	97.7%	97.7%	120.2%	107.4%	97.7% or less
Point System			85.8%	85.8%	85.8% or more
Root Aphid					40% infested or less

Michigan Sugar Company set a goal of “The Road to 19”, having a grower percent sucrose during permanent pile delivery of 19%. This is reflected in the RST requirement increase for 2015-2019. The 2015 requirements were set in 2010. This gave the seed companies a few years to develop varieties we wanted with increased RST and also better Cercospora leafspot tolerance. A lower number is better for Cercospora tolerance.

The Cercospora requirement had been significantly relaxed in 2010. This is because of varieties with the Roundup Ready (RR) trait and also varieties with Cyst nematode tolerance. Varieties for both traits were more susceptible to Cercospora leafspot. There was grower demand for RR varieties even if they did not have the Cercospora tolerance level to meet approval requirements. Cyst nematode tolerance was also needed in a number of fields. When testing the first nematode tolerant

varieties some fields had more than a ten ton increase, which was a 100% increase in yield at the time, but these varieties were also more susceptible to Cercospora. These varieties were popular because of the nematode tolerance but they were also high producers for tons and percent sucrose. Table 4 and 5 shows that RR and Cyst nematode tolerant varieties did not meet the approval standards for Cercospora tolerance to start. In 2007 the year before RR varieties there were 16 varieties that met approval and the only Special Approval variety was for tolerance to Rhizoctonia crown and root rot disease.

Table 4. Roundup Ready Varieties Meeting Variety Approval

Year to Plant	Full Approval	Limited Approval	Special Approval
2008	0	0	3
2009	0	6	7
2010	4	7	10
2011	10	3	12
2012	6	4	7
2013	11	3	4
2014	8	6	4
2015	11	3	3

Full Approval: after three years testing

Limited Approval: after two years testing

Special Approval: not meeting approval requirements but approved to sell

By 2011 many varieties met approval, including the Cercospora requirement, but they were not good producing varieties. The percent RSA for the Fully Approved RR varieties was only 98.1% and it was 105.0% for the Special Approval varieties that did not meet the Cercospora requirement. The improvement in resistance to Cercospora has been slow. It was the 2013 planting season before there were two good tonnage varieties that met all requirements. Table 3 shows the approval standards requiring more Cercospora leafspot tolerance in 2015 and again in 2020. A lower number is more tolerant. In 2020 the Cercospora requirement will be the same as before 2010.

Table 5. RR Varieties with Cyst Nematode Tolerance Meeting Variety Approval

Year to Plant	Full Approval	Limited Approval	Special Approval
2010	0	0	1
2011	0	0	2
2012	0	1	2
2013	1	1	2
2014	1	1	4
2015	2	2	6

Cyst nematode tolerant varieties are just starting to have better Cercospora leafspot and Rhizoctonia tolerance and it is in only a limited number of varieties. For 2015, there are only four varieties that meet approval standards and six that have Special Approval.

The approval requirement being added in 2020 is for tolerance to root aphids. Some varieties being sold now do not have the level of tolerance needed in our growing area. For a number of years we have tested our varieties in a root aphid nursery but it had never been an approval requirement. To give the seed companies time to adjust their breeding program we set the requirement six years ahead.

The other approval requirement is from the Point System. This was developed to include more factors for approval than RSA, RST and Cercospora leafspot tolerance. The Point System includes points for RWS, RST, Cercospora tolerance and also tolerance to Rhizoctonia, root aphids and Rhizomania plus points for emergence. In 2015 points will also be added for tolerance Aphanomyces and Cyst nematode. The Point System level required has not been a large factor in preventing varieties from obtaining approval but it is a good variety selection tool for growers. There are many factors all on one page to see the traits of a variety they are considering or to select the best variety for a problem they have.

Conclusions: One thing we have learned is the seed companies will develop varieties to meet the requirements we have for approval. We have seen this in three ways recently. Our required level for RSA is low compared to the production of current varieties which has resulted in varieties being produced with lower RSA to help meet other requirements. The same thing has happened in Cercospora leafspot tolerance because our requirement has been relaxed for the years 2010-2014. The third area is root aphid tolerance. Root aphids had not been a concern until the late 1990's when there was a bad year for root aphids. It was obvious in grower's fields which varieties were more susceptible or tolerant. The bestselling varieties then were the most susceptible. The varieties that sold changed the next year. In the years after that all varieties contained a good level of tolerance but that has changed in the last few years. Some varieties have been developed with less root aphid tolerance than we need to help them meet other approval requirements. To solve this lack of tolerance we have already announced a root aphid tolerance requirement will be part of our approval requirements starting in 2020. That leads into the second thing we have learned, is to set approval changes a few years ahead. Our goal now is to plan and announce changes five years ahead. We set the 2015 approval changes in 2010 and in 2014 we made changes for 2020. Changing requirements often frustrates breeding programs because making changes in variety traits takes many years. We have made requirement changes years ahead and have not made major changes during that time. This has given time for breeding programs to provide the traits we want.