

A SUMMARY OF THE PLANT BREEDERS' FORUM

by Forum Leader Jay Miller

Two topics were presented and discussed at this forum. The first topic was molecular marker assisted selection presented by two different speakers from different areas of the industry. The first speaker was J. Mitchell McGrath who is working in the public sector. The second speaker was William Doley who is in the private sector.

J. Mitchell McGrath introduced the topic of genetic markers which include the traditional genetic markers based on morphological traits and the newer field of molecular markers. An example of a traditional genetic marker in sugarbeets is the gene responsible for red hypocotyl color. In very general terms molecular markers are biochemical molecules. Useful molecular markers correlate to a particular trait of interest such as disease resistance. The molecular marker must co-segregate with the targeted trait.

J. Mitchell McGrath feels that the public sector should concentrate on three areas of importance concerning molecular markers. They are marker surveys, gene discoveries and improving molecular marker technology. Several strategies based on molecular markers can be made. Areas that he feels the public sector should conduct molecular marker and gene technology research are sucrose accumulation and metabolism, nitrogen metabolism and utilization, disease resistance, ways to reduce linkage drag, advanced backcross QTL's, plus developing new strategies.

William Doley works in the private sector and he stated that the small breeding companies need to rely on existing molecular marker applications. He stated that there are four general areas for use of molecular markers. The general areas are introgression, indirect selection, genetic distance estimate and varietal identification. Using molecular markers for indirect selection is probably the most important technique for breeding programs. Before using molecular markers one needs to analyze the cost effectiveness of the technique compared to the conventional methods of measuring the trait. Markers are most useful if the trait is difficult to measure, expensive to measure and/or takes a long time to measure.

William Doley gave two examples for using molecular marker applications for sugarbeet breeding. The first example was the case of disease resistance selection for rhizomania using a marker for the "Holly" resistant gene. A molecular marker for the "Holly" gene may be very cost effective since field nurseries for evaluating materials are expensive and may be difficult to find. The other example was selecting for "O" type plants from a cross of a "O" type plant X normal sugarbeet plant. In theory the resulting segregating F2 population should have a frequency of 6.25% for recovering "O" type plants. By using molecular markers, many plants can be screened earlier which should result in savings compared to the current procedure.

Both presenters highlighted the importance of the emerging field of molecular markers for sugarbeets research. Molecular markers are another tool the sugarbeet plant breeder can use for selecting desirable traits. Hopefully the benefits of molecular markers will be shown industry wide.

The second topic was seedling emergence and vigor presented by four different speakers. The speakers were Richard Sylvester, Richard Zielke, Richard Watkins and Lee Tunland.

Richard Sylvester, a Michigan sugarbeet grower, introduced this topic. He stated that when he plants beets he feels he needs to plant about 300 seeds in a 100 feet of row hoping to have a stand of 125 to 150 beets per 100 feet. He has a superior planter compared to 15 years ago, and even though spacing within the row has been reduced from 8" to 4" and he still has stand establishment problems. In the last 10 years, average tonnage has dropped from 19 to about 15.5 tons per acre. Sugarbeet seed germinations are running around 90% but 1996 emergence over six locations conducted by Lee Hubbell ranged from 30% to 72%. Weather has delayed spring plant up to 4 weeks during the last six years compared to earlier years. In 1996 Sugarbeet acreage decreased in Michigan by 22%. The growers need to have good, early stand establishment and good yields.

Richard Zielke gave the second presentation on seedling emergence and vigor and shared 1973 data of stand counts taken by Michigan Sugar field staff. The range of percent emergence was from 22 to 92. Richard Zielke also shared germination and emergence data from his official trials. Percent germination results were mostly in the 90's particularly when testing commercial seed but field emergence results ranged from 29% to 71%. Five day germination results may indicate emergence potential. At one 1993 official location where emergence was excellent, he was able to weigh seedlings at about the 3rd leaf stage. The varieties having heavier seedling weights also had the higher percent emergence. Commercial seed typically has better emergence than experimental seed. Richard Zielke feels that in Michigan it will be difficult to obtain percent emergence averages above 60% for any given year.

Richard Watkins gave the third presentation on seedling emergence and vigor. He showed a subset of emergence data from the 1990 to 1996 official trials. He selected a common set of seven varieties over those years. Percent emergence ranged from 50 to 80. Rankings of the varieties changed from year to year. He also showed 1996 official trial data of the top two varieties and the poorest 2 varieties for emergence. The results showed that the emergence of these four varieties were consistent over the five locations. In summary Richard Watkins stated that a variety with poor emergence in one year does not mean it will have poor emergence in the following year and that the emergence of different varieties at different locations in the same year tend to be consistent.

Lee Tunland gave the final presentation for seedling emergence and vigor. His presentation focused on the breeding perspective for seedling emergence. The first point he made was the need to have a suitable evaluation method which would be able to differentiate genotypes, be repeatable, be fast and be cost effective. His second point was that there needs to be genetic variation for the trait in order to make progress. He reviewed the available techniques such as laboratory germination tests, packed sand tests and field trials and found none of the methods to be ideal for breeding purposes. Next he presented results from the Great Western Company's Annual Reports that showed different seed lots of a genotype varied greatly for germinations and field emergence results. The large amount of variation of different seed lots indicated that the environment of the commercial seed production strongly influences seedling emergence. Lastly he showed seedling emergence results from 1993 to 1996 official trials indicating genetic differences. He summarized by stating there is no suitable method to evaluate breeding materials partly due to the confounding effect of the seed production environment. Improvements in seed production and processing technology will probably contribute the most for the short term.

Several questions and comments were made after the presentations.

Lee Panella asked Richard Zielke if seed size, weights or densities were taken of the varieties that were measured for seedling weights. Richard Zielke stated that all the commercial seed was the same size but seed weights and densities were not taken. Garry Smith made the comment that commercial seed typically goes over the gravity table and may be the densities were similar.

William Bortel asked if there isn't a cold germ available for sugarbeets like there is in corn? Kelly Thomas stated that the packed sand test is available and correlates to field emergence. Larry Ronsberg commented that the packed sand tests that American Crystal conducts correlate very well to the field emergence results. Richard Watkins followed up with the question of what are we testing for with cold germ? For better field emergence or for breeding varieties that germinate under cold conditions. Finally Richard Zielke stated that there are studies being conducted to try to correlate cold germ to field emergence.

John Kern asked Richard Sylvester that if backing off the herbicides showed any differences in his sugarbeet crop. Richard Sylvester replied that last year one could see a substantial difference of better plant growth where herbicides were not used. But he raised the risk issue if a grower can afford not to apply herbicides.

John Kern asked Richard Zielke if the varieties of 20 to 30 years ago showed better Aphanomyces tolerance than the current varieties. Richard Zielke stated that he did not know and was going to test the current varieties in an Aphanomyces nursery this coming year if possible. Jay Miller commented that in general the Michigan varieties have more Aphanomyces tolerance than the varieties of the Minnesota-North Dakota sugarbeet areas.

Chris Middleberg suggested to try many different commercial varieties even from different seed production areas.

Steve Bohn commented on the stand loss from spring to fall, up to 28% based on Richard Sylvester's figures. Lee Tungland asked Steve Bohn if this was seedling loss or later season losses. Steve Bohn replied that it was a combination of seedling and later season losses that are primarily due to diseases.

Richard Sylvester commented that the official trials are good for finding genetic differences of varieties but are not good information for the growers since the official trials in Michigan are not plant to stand. Richard Zielke commented that at this time seedling vigor can't be tested so it can't be included in the approval system. Richard Sylvester stated that plant to stand trials will measure seedling vigor.

The discussion of seedling emergence and vigor concluded and no quick solutions were found.