

## AMERICAN CRYSTAL'S VARIETY APPROVAL SYSTEM

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In 1982 American Crystal implemented a sugarbeet variety approval system based on recoverable sugar per ton, recoverable sugar per acre, and Cercospora leaf spot resistance. Prior to that time seed of any variety could be marketed in the Crystal growing area of the Red River Valley, provided it had been tested for three years in American Crystal's coded trials. The purpose of the approval system was to eliminate those varieties with low quality, low root yield, or high susceptibility to Cercospora leaf spot. The approval system is based on variety performance data from the coded trials and on Cercospora leaf spot readings taken at Betaseed's inoculated nursery at Shakopee, Minnesota.

American Crystal conducts commercial and semi-commercial coded trials in the Crystal growing area of the Red River Valley. The trials are conducted at six locations, with eight replicates. We do not require proprietary test data for entry into our coded trials.

Data from semi-commercial trials is adjusted to commercial trial status by comparing the means of four check varieties common to both commercial and semi-commercial trials. An adjustment factor is calculated for each characteristic, and values from the semi-commercial trials are multiplied by these factors to obtain the adjusted data.

Variety approval decisions are based on three year data, averaged across all locations. Initial elimination of varieties was based on 1978, 1979, and 1981 data. Most of our 1980 coded trials were abandoned due to erratic emergence caused by a prolonged spring drought. Varieties were eliminated if: 1) recoverable sugar per ton was less than 100 percent of the mean of all varieties with three year data, or 2) total of recoverable sugar per ton percent of mean plus recoverable sugar per acre percent of mean was less than 195, or 3) Cercospora leaf spot rating was greater than 5.5.

In order to be eligible for unlimited market approval, a variety must be tested in the coded trials for three consecutive years, with at least the last year in the commercial coded trial. To be fully approved, a variety must equal or exceed 100 percent of the mean of presently approved varieties for recoverable sugar per ton. The total of percent of mean of approved varieties for recoverable sugar per ton and recoverable sugar per acre must equal or exceed 195. The Cercospora leaf spot resistance must be equal to or better than a 5.5 equivalent. The 5.5 Cercospora equivalent is calculated by multiplying the three year mean of seven check varieties by 1.158. The same 1.158 factor is used for test market calculations,

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with two year data being used. The purpose of using the equivalent system is to remove yearly variability due to differential severity of leaf spot epidemics in the nursery.

Variety approval and availability of commercial seed are independent. A variety can be approved before a company has produced any commercial seed.

In order to be eligible for test market approval, a variety must be tested in the coded trials, either commercial or semi-commercial, for two consecutive years. The criteria for approval are identical to the full approval criteria, with two year means of the new set of fully approved varieties being used as the basis for comparison. From 1983 through 1990 a maximum amount of 5,000 pounds of each test market variety could be sold. In 1991 that maximum amount has been changed to 7,500 pounds.

For an established variety to remain on the approved list, the three year, all location mean must equal or exceed 97 percent of the mean of the approved varieties for recoverable sugar per ton. The total of percent of mean for recoverable sugar per ton and recoverable sugar per acre again must equal or exceed 195. The three year mean Cercospora rating must be equal to or better than the 5.5 equivalent.

Seed of a variety can be sold for two years past the year in which that variety did not meet one or more of the criteria. If a company wishes to sell that variety for both years, the variety must be included in the coded trials in the year following the year it failed to meet the criteria. Even though it is being tested again, it cannot be reinstated on the approval list, even if the current three year means would attain approval levels. Also, once a variety is eliminated, it no longer is used in the calculation of the mean of approved varieties, even if it is being tested in the coded trials.

When the approval policy was implemented, there was some concern that the system would reduce drastically the numbers of varieties available for sale. Table 1 shows the number of unlimited market, test market and specialty market varieties available for sale to Crystal growers from 1982 through 1991. In 1991 there are 27 varieties on the unlimited market list, eight varieties on the test market list and five varieties on the specialty market list. Instead of being reduced, the number of varieties has grown since 1982.

In 1988, Rhizoctonia and Aphanomyces resistant specialty varieties were added to the approved list. We require coded testing only once every three years for a specialty variety to remain approved. We also have no specific criteria a variety must meet regarding disease resistance, quality, or root yield in order to be approved. In the future it may be necessary to specify minimum approval standards. Undoubtedly the required levels of recoverable sugar per ton and recoverable sugar per acre would be somewhat lower than the mean of the non-specialty varieties. Resistance to Rhizoctonia or Aphanomyces and Cercospora would remain the primary factors in approving or disapproving specialty varieties.

It is important that we examine the results of the approval system in terms of percent of mean of a set of check varieties, since actual values may vary greatly from year to year due to environmental variation. The three varieties that date back to 1978 coded trials are Bush Johnson 19, Hilleshög Monoricca and Maribo Ultramono. In order to have a set of three check varieties as a baseline, we could not include 1990 data, as Bush Johnson 19 and Hilleshög Monoricca were not included in 1990 coded trials. We will use these three varieties as the baseline against which we will measure the success or failure of the approval system.

Recoverable sugar per ton data, presented in Table 2, indicates a sharp increase in the first two years, with very gradual increases thereafter. The increase from 95.2 percent of checks to a high of 101.6 percent of checks is appreciable. It also is possible that the increase is even greater than what the numbers show, if any of the three check varieties were improved genetically for quality during these years. In terms of actual values, we see an increase from 248.1 to a high of 333.2 pounds per ton. Recoverable sugar per acre data in Table 3 shows a steady increase over the years. However, expressed as percent of mean of the three check varieties, recoverable sugar per acre has remained very stable. Again, in terms of actual values we have moved from 6323 to a high of 7818 pounds per acre.

Certainly some of the increases in recoverable sugar per ton and recoverable sugar per acre are due to improvements in nitrogen management and other agronomic practices. However, we believe a significant portion of the increases is due to variety improvement.

One complaint of the system was that we would see a decrease in field emergence and seedling vigor with the high quality varieties. The field emergence and seedling vigor ratings we are observing indicate that the new set of varieties has better stand establishment ability than the varieties grown prior to 1982.

Cercospora ratings, as shown in Table 4, show a modest increase (lower numbers indicate better resistance) in resistance the first year, followed by rather constant ratings. The very susceptible lines were eliminated at the time the system was implemented, and only resistant to moderately resistant varieties have been allowed since that time. Very few varieties have resistance levels that approach the 5.5 equivalent elimination point.

In summary, we believe the variety approval system implemented by American Crystal Sugar in 1982 has resulted in a significant increase in recoverable sugar per ton and a moderate increase in recoverable sugar per acre. This has been very important for our growers because they are paid for recoverable sugar, not for tons alone. We have not observed a loss in field emergence or seedling vigor. In fact there may have been a slight increase in these two important characteristics. The varieties very susceptible to Cercospora leaf spot have been eliminated, and we believe this has led to an overall reduction of

Cercospora inoculum in the Red River Valley, with a consequent decrease in fungicide application.

In 1990 eight companies participated in our coded trials, and for 1991 40 varieties are available for sale. We believe that through the variety approval system, with the cooperation of all the seed companies, we are providing our grower-owners with the best high quality, high yielding, Cercospora tolerant sugarbeet varieties available in the world.

**Table 1**  
**NUMBER OF VARIETIES AVAILABLE FOR SALE**  
**TO AMERICAN CRYSTAL GROWERS**

<u>1982</u> 26	<u>1983</u> 26 (U.M.) + <u>4</u> (T.M.) 30	<u>1984</u> 16 (U.M.) + <u>7</u> (T.M.) 23	<u>1985</u> 18 (U.M.) + <u>12</u> (T.M.) 30	<u>1986</u> 23 (U.M.) + <u>11</u> (T.M.) 34	<u>1987</u> 26 (U.M.) + <u>8</u> (T.M.) 30
	<u>1988</u> 23 (U.M.) 7 (T.M.) + <u>2</u> (S.M.) 32	<u>1989</u> 25 (U.M.) 8 (T.M.) + <u>4</u> (S.M.) 37	<u>1990</u> 26 (U.M.) 7 (T.M.) + <u>5</u> (S.M.) 38	<u>1991</u> 27 (U.M.) 8 (T.M.) + <u>5</u> (S.M.) 40	

**Table 2**  
**RECOVERABLE SUGAR/TON**  
**DATA FOR APPROVED VARIETIES**

<u>Approved Past:</u>	<u>No. of Varieties</u>	<u>Sugar/Ton (Lbs.)</u>	
		<u>Actual</u>	<u>% of Checks*</u>
1983 (78, 79, 81 data)	23	248.1	95.2
1984 (79, 81, 82 data)	13	265.1	98.6
1985 (81, 82, 83 data)	14	256.4	101.1
1986 (82, 83, 84 data)	15	287.3	101.2
1987 (83, 84, 85 data)	19	303.1	101.6
1988 (84, 85, 86 data)	24	330.1	101.0
1989 (85, 86, 87 data)	23	327.4	101.0
1990 (86, 87, 88 data)	24	333.2	100.9
1991 (87, 88, 89 data)	24	328.5	101.6

\* Mean of Bush Johnson 19, Hilleshög Monoricca and Maribo Ultramono

**Table 3**  
**RECOVERABLE SUGAR/ACRE DATA**  
**FOR CRYSTAL APPROVED VARIETIES**

<u>Approved Past:</u>	<u>No. of Varieties</u>	<u>Sugar/Acre (Lbs.)</u>	
		<u>Actual</u>	<u>% of Checks*</u>
1983 (78, 79, 81 data)	23	6323	100.3
1984 (79, 81, 82 data)	13	6325	99.3
1985 (81, 82, 83 data)	14	6457	99.5
1986 (82, 83, 84 data)	15	6929	99.7
1987 (83, 84, 85 data)	19	7052	98.7
1988 (84, 85, 86 data)	24	7469	99.0
1989 (85, 86, 87 data)	23	7801	99.7
1990 (86, 87, 88 data)	24	7818	101.0
1991 (87, 88, 89 data)	24	7249	100.6

\* Mean of Bush Johnson 19, Hilleshög Monoricca and Maribo Ultramono

**Table 4**  
**CERCOSPORA RATINGS**  
**FOR CRYSTAL APPROVED VARIETIES**

<u>Approved Past:</u>	<u>No. of Varieties</u>	<u>Cercospora Rating*</u>	<u>% of Checks**</u>
1983 (78, 79, 81 data)	23	4.99	97.8
1984 (79, 81, 82 data)	13	4.71	90.6
1985 (81, 82, 83 data)	14	4.98	92.9
1986 (82, 83, 84 data)	15	5.03	98.2
1987 (83, 84, 85 data)	19	4.82	94.7
1988 (84, 85, 86 data)	24	4.74	95.8
1989 (85, 86, 87 data)	23	4.95	97.2
1990 (86, 87, 88 data)	24	4.84	98.8
1991 (87, 88, 89 data)	24	4.92	97.6

\* Lower numbers indicate better Cercospora resistance.

\*\* Mean of Bush Johnson 19, Hilleshög Monoricca and Maribo Ultramono