

REACTIONS OF SWEET CORN HYBRIDS TO PREVALENT DISEASES

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Common rust (*Puccinia sorghi*), northern leaf blight - NLB (*Exserohilum turcicum*), Stewart's bacterial wilt (*Erwinia stewartii*), maize dwarf mosaic - MDM (MDM viruses), southern leaf blight - SLB (*Bipolaris maydis*), anthracnose leaf blight - ALB (*Colletotrichum graminicola*), southern rust (*Puccinia polysora*) and gray leaf spot - GLS (*Cercospora zeaemaydis*) are endemic diseases of sweet corn grown in North America. Reactions to these diseases vary among commercial sweet corn hybrids. Since 1984, nearly 2,500 hybrids have been evaluated for disease reactions in nurseries at the University of Illinois at Urbana-Champaign. In each trial, hybrids were classified as resistant (R), moderately resistant (MR), moderate (M), moderately susceptible (MS), and susceptible (S) based on standard deviations from trial means (z-scores), separations based on multiple comparison tests (BLSD), and multivariate clustering procedures. This type of classification produces statistically "overlapping" groups without clear-cut differences between classes (e.g., the hybrids with the least severe symptoms in the MR class do not differ significantly from the hybrids with the most severe symptoms in the R class). Nevertheless, a consistent response of a hybrid over several trials gives a reasonable estimate of the disease reaction of that hybrid relative to all other sweet corn hybrids. These reactions can be used to plan disease management strategies by assessing the potential for diseases to become severe and affect yield of a specific hybrid.

Results of the annual disease nurseries have been reported each year in the Midwestern Vegetable Variety Trial Report. Results of recent nurseries also are available on the web at www.sweetcorn.uiuc.edu. This article summarizes the disease reactions of 707 commercially-available hybrids that have been evaluated in UIUC nurseries since 1984. The summary includes reactions of 153 sugary hybrids (144 yellow, 3 bi-color and 6 white), 186 sugary enhancer hybrids (65 yellow, 82 bi-color, 37 white, and 2 red), 361 shrunken-2 hybrids (196 yellow, 104 bi-color, 60 white and 1 multi-color), and 7 brittle hybrids (6 yellow and 1 white).

GENERAL INFORMATION

Details about specific trials are reported annually in the Midwestern Vegetable Variety Trial Report. Plants usually were inoculated with *P. sorghi*, *E. turcicum*, *E. stewartii*, *C. graminicola*, *B. maydis*, *P. polysora*, *C. zeaemaydis* or maize dwarf mosaic virus to insure uniform disease pressure. Some evaluations of reactions to GLS, MDM and Stewart's wilt were based on natural infection when disease pressure was relatively uniform.

In this summary, hybrids are grouped by: **i) endosperm phenotype:** sugary, sugary enhancer, shrunken, and brittle **ii) kernel color** (yellow, bi-color, white, and other), and **iii) alphabetically by hybrid name**. Hybrids with multiple endosperm mutations (e.g., sweet breeds, triples sweets, extra tenders) are placed under the most appropriate of the four categories of endosperm phenotypes. The table includes: seed source (seed company which entered the hybrid in the nursery), endosperm type (ET), kernel color (KC), relative maturity (RM) from 1 to 5 as reported by each seed company (where 1 = first early, 2 = second early, 3 = mid-season, 4 = main season, and 5 = full season), hybrid name, and reactions to diseases: common rust, NLB, Stewart's wilt, MDM, SLB, ALB, southern rust, and GLS.

Disease reactions are averaged over all trials in which a hybrid was evaluated and are presented on a 0 to 9 scale, where: 0 = no disease, 1 = resistant, 3 = moderately resistant, 5 = moderate, 7 = moderately susceptible, and 9 = susceptible. Reactions listed as 2, 4, 6, 8, are between these categories (e.g., 2 indicates a reaction between resistant and moderately resistant, i.e., R-MR). Hybrids with *Rp*-reactions to rust are designated 'Rp' and reactions to avirulent (av), D-virulent (D-v) and/or G-virulent (G-v) populations of *P. sorghi* are listed. The number of trials in which a hybrid was evaluated for each disease is noted with a superscript. For example, the reaction of the yellow sugary hybrid Bonanza to northern leaf blight is listed as 2³. This indicates that the NLB reaction of Bonanza relative to all sweet corn hybrids is between resistant and moderately resistant (i.e., rxn = 2) and this average is based on the 3 trials at UIUC in which Bonanza was evaluated.

INTERPRETATION OF DISEASE REACTIONS

Resistance and susceptibility are the two extremes of a continuum of host reactions to diseases. Resistance measures the ability of the host to reduce the growth, reproduction, or disease-producing abilities of the pathogen, thus resulting in less severe symptoms. Major genes for resistance, such as *Rp*, *Ht*, or *Mdm1*, can prevent or substantially limit disease development if specific virulence is not present in pathogen populations. Hybrids with major gene resistance usually have clearly distinguishable phenotypes. Major gene resistance may be ineffective when specific virulence occurs. For example, Rp-resistance based on the *Rp1-D* gene is not effective when D-virulent isolates are the predominant race of rust.

If hybrids do not have effective major gene resistance, disease reactions often range from partially resistant to susceptible. Since our nurseries have included most of the sweet corn hybrids available commercially, our ratings reflect the disease reactions of a hybrid relative to all sweet corn.

Hybrids rated 1 or 2 (R or R-MR) were among the best hybrids evaluated in our trials in the past 20 years. Those rated 9 were susceptible (S) and were among the worst. The moderately resistant ratings (3) included hybrids with disease reactions that were better than average. The moderately susceptible ratings (7) included hybrids that were worse than average. Hybrids with moderate ratings (5) had average reactions. Classification of hybrid reactions can vary among years (e.g., some hybrids may have been classified M in one trial and MR or MS in another trial due to random variation or other factors). Average reactions based on at least three or more trials are probably more accurate than estimates based on one or two trials.

Symptoms may occur on hybrids rated R, but the amount of the disease on these hybrids is less than the amount on hybrids rated MR, M, MS, or S. Similarly, the effects of diseases on yield should correspond to this scale of hybrid reactions.

Common rust. Rust reactions are more complex now because of races that are virulent against the *Rp1-D* gene and a few other Rp-resistance genes. If a hybrid does not have Rp-resistance, the rust rating is given in the first column. These hybrids should have the same reaction to all races of rust. For example, the

reaction of Bonanza to common rust is moderately susceptible/susceptible based on 3 trials (i.e., the rating in the rust column is 8³).

Rp-resistance is noted by 'Rp'. Reactions of hybrids with Rp-resistance are listed separately for avirulent, D-virulent, and G-virulent races of rust. For example, in four trials with avirulent populations of *P. sorghi* (i.e., the "old race"), the yellow sugary hybrid Bold had an Rp-reaction (no rust: 0⁴). In three trials with the D-virulent populations of *P. sorghi* (i.e., the "new race"), Bold had a susceptible reaction (9³). Bold has not been evaluated in a trial with G-virulent rust.

Even though Rp-resistance of most sweet corn hybrids is based on the *Rp1-D* gene, many newer hybrids may have resistance based on *Rp1-E*, *Rp1-I*, *Rp1-K* or *Rp-G* genes or based on compound rust resistance genes (e.g., *Rp-GI* or *Rp1-JFC*). Hybrids with these Rp genes may be infected by some populations of rust but not others. For example, the yellow sugary hybrid GH 2042 was Rp-resistant in a trial when D-virulent rust was present, but it was infected by rust and had a moderately resistant (3) reaction in a trial when G-virulent rust was present. Conversely, the yellow sugary hybrid GH 5703 was Rp-resistant in trials with D-virulent and G-virulent rust.

Three-hundred and three hybrids have Rp-resistance to common rust, but only 23 of those hybrids are resistant against D-virulent rust. Of the hybrids that did not have Rp-resistance, 46 had R-MR or MR reactions (2 or 3) and 112 had reactions that ranged from MS to S (7 to 9). Significant yield losses due to rust are most likely to occur on those 112 hybrids. Sweet corn yield is reduced about 5% for each 10% of the leaf area infected with common rust.

Northern leaf blight. One hundred and seventy-six hybrids had reactions to NLB that ranged from R to MR (1 to 3). Many of these 176 hybrids have *Ht* genes (*Ht1* or *HtN*) in addition to good levels of polygenic resistance to NLB. Yield of hybrids with R to MR reactions will be affected very little by NLB unless environmental conditions are extremely favorable for disease development. Yield of sweet corn usually is not affected by NLB until more than 15% or 20% of the leaf area is symptomatic. Yield of 192 hybrids with NLB reactions that ranged from MS to S (7 to 9) can be reduced substantially by NLB under disease favorable conditions.

Stewart's wilt. Infection by *E. stewartii* should be very limited on 191 hybrids with reactions from R to MR (1 to 3) although some systemic infection and yield reduction may occur on these hybrids if flea beetles feed on emerging seedlings. This usually occurs under extremely dry conditions when populations of flea beetles are very large. Stewart's wilt reactions of 413 hybrids ranged from M to S (5 to 9). Stewart's wilt infection can be systemic on these hybrids and infection will be more severe on hybrids that are more susceptible. Seed treatment insecticides or other treatments to control flea beetles may be advantageous on M to S hybrids when warm winter temperatures indicate that flea beetles may be present and Stewart's wilt is likely to occur.

Maize dwarf mosaic. Most sweet corn hybrids are moderately susceptible to susceptible (6 to 9) to this MDM. However, 84 hybrids evaluated for MDM had reactions that were resistant to MR (1 to 3). Seventeen hybrids had reactions that ranged from MR-

M to M. Most of these hybrids probably have the *Mdm1* resistance gene. MDM resistance in some hybrids may differ between MDMV-A and SCMV-MB (i.e., MDMV-B).

Southern leaf blight. Over a third of the hybrids evaluated for SLB had R to MR reactions. Only 64 hybrids had reactions that ranged from MS to S.

Anthracnose leaf blight, southern rust, and gray leaf spot. Fewer hybrids have been evaluated for reactions to ALB, southern rust and GLS than for other diseases. With the exception of one hybrid (Sure Gold) that has *Rpp*-resistance to southern rust, none of the hybrids are highly resistant to southern rust or GLS. In fact, the reactions of most hybrids to these two diseases range from M-MS to S. Of the hybrids evaluated for ALB, 47 have reactions from MS to S and 64 have reactions from R to MR.

Table 1. Reactions of commercially-available hybrids to diseases in the UI disease nurseries from 1984 to 2003

	Number of hybrids in each reaction category									
	Rp 0	Resistant 1	Moderately resistant 2 3		Moderate 4 5	Moderately susceptible 6 7		Susceptible 8 9		
Common rust	303	0	15	31	40	99	99	55	29	28
Rp1-D-virulent*	23	1	4	29	44	53	57	15	5	7
NLB		11	61	104	90	139	95	89	62	41
Stewart's wilt		26	52	113	80	151	99	86	44	33
MDM		40	19	25	4	13	7	40	35	319
SLB		27	56	97	98	76	48	37	11	16
ALB		15	11	38	18	55	22	25	13	9
Southern rust	1	0	0	1	0	6	48	38	49	60
GLS		0	1	9	59	81	120	52	35	21

Classification: 0 - Rp-resistance, 1 - resistant, 3 - moderately resistant, 5 - moderate, 7 - moderately susceptible, 9 - susceptible.

* Reactions of Rp-resistant hybrids to biotypes of *P. sorghi* virulent against the *Rp1-D* gene.

In the past 20 years, several people have participated in annual evaluations of hybrid reactions in the University of Illinois sweet corn hybrid disease nursery, including: John Headrick, Suparyono, Payam Fallah, John Gantz, Annette Meyer, Claude Nankam, Mike Kerns, Lindsey du Toit, Phil Michener, Noah Freeman, Molly Pate, Mirian Gonzalez, Andrea Campana, Mohammad Babadoost, and Tatjana Ledencan.