Barley Yellow Dwarf

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The Barley Yellow Dwarf Research Program at CIMMYT

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Barley yellow dwarf (BYD) is a ubiquitous disease. The symptoms of BYD in bread wheat, durum wheat and triticale are, firstly, not particularly apparent and, secondly, not well-recognized, even by experienced cereal workers. It has only recently become apparent how widespread this disease is. Unfortunately, a great deal of the diagnostic ability for BYD is currently found in the developed world.

BYD could be considered a second generation or second level disease. Severe rust, septoria or scald epidemics can totally mask diseases such as BYD and, historically, have probably done so. However, once resistance has been developed to those diseases, the effects of the second generation diseases become apparent. BYD, like the rusts, is not a problem every year; it has a third biological variable, the aphid vector, and conditions that influence the aphid vectors influence the spread and epidemiology of BYD.

Germplasm development and distribution is the essential task of CIMMYT and, after the 1980 Barley Yellow Dwarf Workshop sponsored by CIMMYT at the El Batan headquarters in Mexico, a proposal was prepared for the development of a BYD project. The objectives of the project, in general, were to:

- Conduct epidemiological studies on BYD, looking in particular at the cropping systems used for wheat (both bread and durum), barley and triticale;
- Identify virus strains;
- Identify the species of aphids that are the vectors of BYD;
- Identify BYD-resistant germplasm by screening cereal collections. Included would be hybridization of resistant lines and distribution to areas with particular BYD problems. The whole system would cycle with site-specific evaluations being taken into account in the hybridization;
- Evaluate cultivars and elite breeding lines for resistance to BYD, assuring free access to the material for cooperators and others with interest in the program;
- Determine the genetic basis of BYD resistance;
- Run site-specific evaluations on material selected for BYD resistance;
- Train researchers in BYD methodology, and
- Set up workshops and ensure the dissemination of information through publications.

Since the 1980 workshop, CIMMYT, and particularly the bread wheat and barley programs, have noted lines reported to be resistant to BYD by cooperators, and have utilized Toluca, with its natural epidemics of BYD, as a winter site for selecting BYD-resistant material.

The winter cycle testing site at Toluca initially worked well for bread wheat but less well for barleys; after the distribution of the first nursery it became apparant that the site did not permit complete differentiation between winter hardiness and BYD resistance. Currently, there is an additional problem with the site; infestation with the aphid *Diuraphis noxia* was so severe in the winter of 1983 that the symptoms it caused completely masked BYD symptoms on both wheat and barley. It is not known whether Toluca will be usable as a winter BYD screening site in the future.

Lines selected in Toluca in 1982 were utilized to form initial BYD nurseries and, through the cooperator network, they were sent to specific sites for preliminary evaluation. Although it would be extremely helpful if all cooperators could inoculate their plots with viruliferous aphids in the way described by A. Comeau in these proceedings, most cooperators have to depend on natural infestations of aphids, making epidemics inconsistent from year to year. It is felt that, if cooperators would seed their plots as if they were spaced plants, the results obtained under natural epidemics could be greatly enhanced. It may be possible for some cooperators to increase infection by providing borders of BYD-susceptible cereals to act as reservoirs for aphids and virus for the inoculation of nurseries in the way described by C.O. Qualset in these proceedings. Most CIMMYT nurseries, with the exception of yield trials, are sown as a single plot. Again, it is felt that the reliability of results obtained from a BYD nursery would be greatly enhanced by replication.

The preliminary BYD bread wheat nursery was obtained for initial screening at Toluca. It contained 89 entries, including two check lines with every 20 entries, and was sent to six selected sites. So far, usable data has been received from only two screening sites, New Zealand (J.M. McEwan) and Canada (A. Comeau). Table 1 lists the scores from those entries that were checked as being good in Canada and that had a rating of 5 and below in New Zealand; the mean score of the checks is also given. It should be stresed that all of these entries appeared to have a high level of resistance in the initial screening in Toluca. It can be seen that there is a large variation in resistance over sites. However, some entries show good resistance at both sites, e.g., entries 47, 54, 63 and 71.

BYD epidemics are natural at the Palmerston North site in New Zealand and, therefore, are not nearly as severe as those created at the Quebec screening site.

Currently, all wheat nursery reports received by CIMMYT are surveyed, and any entry that is rated BYD-resistant from any site will be considered for inclusion in the next BYD bread wheat nursery to be distributed in 1985-86.

The barley lines for inclusion in the initial BYD barley nursery were also selected in Toluca. That preliminary nursery consisted of 169 entries (129 spring and 40 winter barleys) and was distributed in 1982. To date, only three reports have been received from cooperators, again from Canada (A. Comeau) and New Zealand (J.M. McEwan), as well as from Spain (J. Hernando Velasco). Table 2 lists the spring materials that exhibit resistance at any of the sites. There are a number of entries that exhibit good resistance at all sites, but it is apparent that there are still many notable reversals; a line that is resistant at one site often appears susceptible at another. This again points out the neccessity for multisite testing.

Table 1. BYD Scores for Entries in the Preliminary BYD Bread Wheat Nursery, from Cooperators at Two Sites[a/]

Entry no.	Cross	Saint-Foy Quebec, Canada (A. Comeau)	Palmerston North, New Zealand [b/] (J.M. McEwan)
1	R37-GHL121 x KAL-BB	7.7	5
2	FLN-ACC x ANA	6.9	3
5	KEA "S"	8.0	5
6	PRL "S"	7.5	5
8	PRL "S"	7.4	3
9	PRL "S"	7.6	4
17	[JUP[7C-PATO(B)/LR64-INIA x INIA-BB]]ANA	7.0[c/]	6
18	GH "S"	7.0[c/]	7
19	TI RESEL-HUAC "S"	7.6	5
22	MAYA-NAC	7.7	4
23	JUP-BJY "S"	7.7	5
24	JUP-BYJ "S"	7.7	3
25	BJY "S"-JUP	7.5	5
27	NKT "S"	7.7	4
28	NKT "S"	7.6	4
29	NKT "S"	7.5	5
30	NKT "S"	7.7	3
31	DGA-BJY "S"	8.2	3
32	DGA-BJY "S"	7.5	3
33	DGA-BJY "S"	7.6	5
35	DGA-BJY "S"	7.6	3
36	DGA-BJY "S"	7.6	3
37	[58.57 (MAYA "S"-CGN/CC-INIA x CAL)	7.5	5
38	YACO "S"7.7		5
39	YACO "S"	7.7	5
43	YACO "S"	7.8	4
44	YD "S"/TOB-ERA x TOB-CNO67	7.6	5
45	BAYA "S"	7.6	5
47	TOB-CNO67 x TOB-ERA/NAC	7.4[c/]	4
48	CNO67-MFD x MON "S"	7.4	4
51	F35.70-MO x NAC	8.0	4
52	F35.70-MO x NAC	8.2	5
54	BBY2-BJY "S" x JUP	7.5[c/]	4
55	JUP-EMU "S" x GJO "S"	7.7	4
56	JUP-EMU "S" x GJO "S"	7.3	4
57	JUP-EMU "S" x GJO "S"	7.6	4
58	JUP-EMU "S" x GJO "S"	7.0	4
63	DODO "S"	7.4[c/]	4
65	COQ "S"-PVN "S"	7.6	5
67	PF70354-MUS "S"	7.6	4
68	PF70354-MUS "S"	7.7	5
69	CAR853-COC x VEE "S"	7.6	4
70	BAGE-HORK "S" x ALDAN "S"	7.6	5
71	ERA-MN69146 x PVN "S"	6.6[c/]	5
73	DOVE "S"-CNT7 [ALD "S" (BB-GLL x CN067-7C/KVZ-TI)]	7.5	5
75	P.AR-H567.71	6.9	4
76	GOF "S"-ALD "S"	7.8	5
77	S SEAFOAM x SOTY-JN(3)	7.0	5
79	B7455	7.2	5
87	IAS63-ALD "S" x GTO-LV	7.6	5
88	IAS63-ALD "S" x GTO-LV	7.8	5
89	IAS63-ALD "S" x GTO-LV	7.8	5
Checks	Anza	7.5	4
	Nacozari 76	8.0	4.75

a/ Scoring system 0 to 9 (0 fully resistant, 9 fully susceptible) as described by C.O. Qualset, these proceedings

b/ All entries scoring 5 and below selected as having good resistance in New Zealand

c/ Entries selected as having good resistance in Canada

Table 2. BYD Scores for Entries in the Initial BYD Barley Nursery, from Cooperators at Three Sites[a/]

Entry no.	Cross	Saint-Foy, Quebec, Canada (A. Comeau)	Palmerston North, New Zealand (J.M. McEwan)	Madrid, Spain (J. Hernando)
1	PRO	5.8	2[b/]	3
2	CQ-UN6. UN3	5.0[b/]	7	3
3	HOR728	5.3[b/]	5	5
9	COMA "S"	6.5	7	1[b/]
11	NABO "S"	6.7	7	1[b/]
12	API-CM67 x ORE	6.0[b/]	6	1
14	CACO "S"	5.5[b/]	2[b/]	1
16	HD-ATHS x PYO-DL 70/APM-5106	6.5[b/]	8	3
29	SUTTER	6.5[b/]	0[b/]	5
31	79AN-MN	6.5[b/]	8	5
34	BEN-4D	6.0[b/]	2[b/]	3
35	CEDRO "S"	9.0	2[b/]	0
36	CHINO "S"	5.0[b/]	3	0
37	BREA "S"-SUTTER x F_3 BULK HIP	6.5	1[b/]	1
43	SOT-ABN x GAS-ORE "S"	5.5[b/]	4	1
44	POCHE "S"	6.7	2[b/]	3
47	ABN	6.7	0[b/]	3
48	NIGRINUDUM	7.3	2[b/]	0
50	PI382406	6.7	0[b/]	1
51	GOB "S"	8.7	3	0
52	PYO-RM1508 x DOR DIST/EMIR	7.7	4	3[b/]
53	DEIR ALLA 105	9.3	3[b/]	3
58	DRAGO "S"	6.5[b/]	9	7
61	ASSE-NACKTA x VILLA ROBLEDO/PYO	5.0[b/]	1[b/]	0
63	BFL "S"	6.0[b/]	5	0
64	BREA "S" x MCU377. 24D-BEN/NPL x BCO. MR-GVA	6.5[b/]	3	1
67	OJL "S"	6.5[b/]	2[b/]	0
68	OJL "S"	6.5[b/]	1[b/]	1[b/]
70	LIMA PERU581 x BCO. MR-AS46/BREA "S"-DL70	6.5[b/]	7	0
79	LIGNEE640	7.0[b/]	1[b/]	0
80	HOBO "S"	7.5	6	0[b/]
85	P.STO "S"	8.0	0[b/]	0
88	BGS-10876.1	6.5[b/]	7	3
95	(BURK^2-APRO x 11016.2/BREA "S") G134-APM x NACKTA	7.0	8	5[b/]
97	BUSSELL	7.3	6	1[b/]
102	U.SASK HARVEY 143-BAL16/BCO.MR-AVT x CEL	6.7	1[b/]	7
103	U.SASK HARVEY 144-BAHTIM10 x CEL-CI3909.2	5.7	1[b/]	7
105	11012.2-MZQ x MZQ-BEN	7.0	8	3[b/]
106	CI424 x G134-APM/BIDGC-GAS x APM-HC1905	6.3	7	0[b/]
111	(API-CM67 x APM-B65/API-CM67 x B266.L2966.69) BEN	6.7	3[b/]	3
113	API-CM67 x DL71/ROW906.73	5.7[b/]	7	3
115	ALAMO "S"	6.0[b/]	4	3
118	ORE"S" x API-CM67	5.0[b/]	3	3
125	ORE"S" x INDIAN DWARF-CM67	6.5	1[b/]	3
127	API-CM67 x AGER	6.7[b/]	1[b/]	3
128	APM-GVA x POR-U.SASK1800/API-CM67 x DS-APRO	6.5[b/]	4	5

a/ Scoring system 0 to 9 (0 fully resistant, 9 fully susceptible) as described by C.O. Qualset, these proceedings

b/ Entries selected by cooperators as having good resistance

A second BYD barley nursery has now been distributed. It contains 43 spring barleys, including California Mariout and Atlas 57 as susceptible checks and CM 67 and Atlas 68 as resistant checks; results are not expected from this nursery until late 1984 or early 1985. The lines included were selected from the first BYD nursery on the basis of data from reports received from cooperators on other CIMMYT barley nurseries. Spring x winter barley crosses are now being made in Mexico in an attempt to transfer the BYD resistance in winter material (D.T. Sechler, these proceedings) to spring material.

Strong links to programs that are screening germplasm are being developed. Currently, there is more interest in materials that are relatively well-adapted, since they are readily usable; wild relatives, however, will be used if they supply good resistances. Screening of materials for BYD resistance, will be done at CIMMYT, providing coordination for groups doing germplasm screening around the world. CIMMYT is in a good position to act as a clearing house for obtaining, adding to and distributing material for further BYD screening.

From preliminary results, it appears that screening at different sites is important as there appears to be much between-site variation in resistance. Resistance from different sites should be intercrossed and subsequently distributed for further testing. Current data is preliminary and further testing is required at a greater range of sites before more reliable data can be expected. The real strength of the CIMMYT BYD program will depend, to a great extent, on the feedback from its cooperators.