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AGENCY FOR INTERNATIONAL DEVELOPMENT
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MEMORANDUM

TO: AID/PPC/CDIE/DI, room 209 SA-18

FROM: AID/SCI, Victoria Ose

SUBJECT: Transmittal of AID/SCI Progress Report(s)

Attached for permanent retention/proper disposition is the following:

AID/SCI Progress Report No. C5-039
IRT annual report
12/86 - 11/87

Attachment

1 cy

U.S - ISRAEL COOPERATIVE DEVELOPMENT RESEARCH PROGRAM (CDR)

SCREENING, TRANSFER AND INCORPORATION OF ALIEN GENETIC MATERIAL INTO WHEAT GENOMES FOR RESISTANCE TO THE "TAKE-ALL" DISEASE

Project No. C5-039

First Annual Report: December 1986 - November 1987

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February 1988

STUDIES CONDUCTEO IN ISRAEL

Genetic resources and collection of Triticum dicoccoides in israel

The first genetic resource screened for "take all" resistance was Triticum dicoccoides Korn. This species was collected from wild habitats all over Israel. This collection consists of more than 800 accessions from 350 collection sites and it is representative of the entire distribution area of the species in Israel. Phtogeographically this distribution area includes three distinct regions which can be found in Israel e.g. Subalpinic, Mediterranean and Irano-Turanian. The accessions were collected in Israel from north to south (see map) from MT. Hermon, Golan Height, Upper Galilee, Jorden Valley, Samaria Mountains, Judean Mountains and Judean Desert. This means range of annual rainfall from 1300 mm to 300 mm under which the wild populations grew in nature. Edaphically the wild populations collected grew on basetic soils, hard limestone, dolomitic bedrocks and rendzina soil. Topographically the T. dicoccoides accessions were collected from habitats at altitude ranging from 1300 m above the sea level to - 150m below the sea level. The collection represents enormous variation between and within populations. Phenologically it consists of accessions with winter habit as well as of spring types. Morphologically there is variation between robust large cereal types and small grassy types. Head pigmentation varies between black, white and red e.g. var. spontaneonigrum, var. kotschyanum and var. aaronsonii respectively. Also qualitative charecteristics such as protein content were analyzed and found to range between 15-30 percent.

Development of a standard screening method in a growth room

Isolates. Eight isolates of Gaeumannomyces graminis var. tritici, (G.g.t.), collected in different wheat fields in Israel during 1985 and 1986, were maintained on PDA slants. Their virulence was assessed with the tube method (described later). There was minor variation among the isolates, two of which (Harel 85 and Galon) being somewhat less virulent. Generally all the isolates were highly virulent and their virulence was not decreased during two years of occasional transfer on PDA. In the experiments for screening for resistance we used various isolates with high virulence. Details on virulence test in table 1.

Methods of inoculation. Various sources and containers were assessed as to reliability, reproducability and also space and time needed for each test. Naturally infested soil collected from a field in Harel was mixed with sterile sand (1:1) and planted with various wheat, emmer wild wheat and rye in 1-l pots. After 5 weeks the roots were washed and examined for infection. Infection was rated from traces on rye up to 70% on cultivated wheat. However, sometimes there were marked variations among individual plants. Furthermore, for a long term work the inoculum might change with time; also 1-l pots occupy large space in the growth room. We decided not to use this method for preliminary screening but it will be used at an advanced stage as one of several tests to verify previous screening tests. After trying several conical tubes and growth media (perlite, sand and vermiculite) as well as inoculum types (infected oat grains and culture disks) We decided to adopt the 15-ml plastic tubes. The effect of the size of

the inoculum disk was examined on four standard species, representing a spectrum of susceptibility. The results are presented in Table 1. Generally the infection score was lower with the smaller disk, but not to a substantial degree, except on rye.

Table 1. Comparison of 5 isolates of Ggt and two levels of inoculum: large or small disk

Isolate	WHEAT		TRITICALE		BARLEY		RYE	
	Large	small	Large	small	Large	small	Large	small
Menachem	3.0	2.5	2.9	2.1	1.3	1.2	3.0	1.6
Harel 87	3.0	2.2	2.5	2.0	1.6	1.5	1.8	1.5
Nahala	2.7	2.1	2.2	1.7	2.2	1.7	1.7	0.4
Bet Nir	2.8	3.1	2.7	2.2	1.5	1.0	2.2	1.4
Galon	1.7	2.1	2.0	0.8	1.3	0.5	0.4	0.3

The following method was established as our standard screening procedure.

Plastic tube test for assessing susceptibility to G.g.t.

Conical 15-ml clear plastic tubes were filled 2/3 with vermiculite (No. 3), and a disk of culture, 12 mm diameter, was placed on the vermiculite. The inoculum was covered with vermicolite (1-2 cm), and one seed was planted and covered with another layer of vermiculite (1-2 cm). The tubes were watered at 2-3 days intervals and maintained in a growth-room at 16°C with a 16 hrs light. After 21 days the plants were washed carefuly and the proportion of discoloration of the root system (seminal roots only) was determined by estimation. The following scores were used:

0 - no discoloration
1 - 1-10% infection
2 - 11-25% infection
3 - 26-50% infection
4 - 51-75% infection
5 - 76-100% infection

The average score of an accession was calculated from the average score of the replicates. In each test a set of standards, comprised of wheat, triticale, barley and rye which represent a range of disease reaction of susceptible, moderately susceptible, moderately resistant and resistant, respectively, were included. The lines of the standards were: Barkai (Triticum aestivum), Manchuria CI 2330 (2-807) (Hordeum vulgare), Weser rye CI 33 (24-897) (Secale cereale). The ranking of disease reaction of the screened accessions in each test was determined by comparison to the reaction of the standards.

Screening of accessions of wvild emmer wheat (T. turqidum var. dicoccoides) for resistance to take-all.

Accessions were screened throughout the year in successive experiments, designated by experiment No. At different tests various isolates were used, as indicated. The results are presented in the following tables at the end of this report.

The screening results of wild emmer wheat show that some accessions were less infected than others, sometimes comparable to barley or even rye. they were ranked as moderately resistant (MR) or resistant (R). When the number of replicates was very small, or no infection had occurred a ? was indicated. We consider these results as preliminary results that must be verified by further tests of similar nature, as well as more comprehansive tests. However, the preliminary tests indicate that there is a good chance of finding a considerable resistance in germplam of T. turqidum var. dicoccoides.

Description of cooperation between the Israeli and the Portuqese investiqators.

The investigators of both countries met to discuss the details in each country, exchange of information and materials. The methodology of evaluation and screening resistance in wild emmer wheat and other cereals of lines collected in Israel during the first year of the study, and prior to the study, were reviewed. It was decided that the tests in Israel will be based mainly on ranking susceptibility

according to disease development on the root system. While in Portugal the tests will be aimed toward testing both the effect of the disease on growth and yield potential, as well as scoring root infecion. The tests in Portugal will be conducted in pots with infested soil. After establishing a collection of isolates of G.g.t., some highly virulent and some low virulent stdains will be selected for further studies. At first, the optimal concentration of inoculum will be determined so that the inoculum pressure will not be too severe, yet escape from infection will be unlikely. Every experiment will include 3 levels of inoculum, when the test procedures will be established, the best accessions selected in Israel will be evaluated.

A histopathological study to asses host-pathogen relationship between various genotypes and isolates of G.g.t. will be conducted. Both light and electron microscopy will be employed. Samples of roots infected by several isolates of G.g.t. were delivered from Israel to Portugal for their study.

As soon as relatively resistant genotypes of emmer wild wheat are detected in Israel, they will become available for genetic program in Israel and in Portugal. This will include crosses with best wheat cultivars.

ACCESSION No. (IDENTIFICATION)	EXPERIMENT No.	INOCULUM SOURCE	NUMBER OF PLANTS	SCORE	RANKING
52	10		1	3.4	
57	10		2	2.3	
58	10		2	2.7	
59	10		2	2.3	
64	10		1	2.5	
70	10		2	2.6	
71	10		2	2.4	
72	10		2	2.7	
74	10		2	2.8	
75	10		2	2.9	
76	10		2	2.8	
84	10		2	1.7	
85	10		2	2.3	
86	10		1	0.0	R?
89	10		2	1.7	
87	10		2	2.5	
90	10		2	2.5	
91	10		2	2.7	
92	10		2	2.1	
93	10		2	1.1	MR
94	10		2	1.5	
95	10		1	2.0	
96	10		2	1.5	
97	10		1	3.2	
98	10		2	2.5	
99	10		2	2.0	
100	10		2	1.9	
104	10		2	2.4	
109	10		2	2.1	
110	10		2	1.5	
111	10		2	0.9	MR
112	10		1	2.2	
114	10		1	0.8	MR
115	10		1	3.0	
116	10		2	2.1	

ACCESSION No. (IDENTIFICATION)	EXPERIMENT No.	INOCULUM SOURCE	NUMBER OF PLANTS	SCORE	RANKING
117	10		2	2.4	
118	10		2	1.8	
119	10		1	3.2	
120	10		1	2.6	
121	10		1	2.5	
122	10		1	2.2	
123	10		2	2.4	
124	10		2	2.3	
WHEAT	10		3	2.4	
TRITICALE	10		5	2.0	
BARLEY	10		3	0.7	
RYE	10		5	0.1	
125	11		2	2.5	
127	11		2	2.4	
128	11		2	3.1	
129	11		2	3.4	
130	11		2	2.4	
131	11		2	2.7	
132	11		2	1.9	MR
133	11		2	3.0	
134	11		1	2.3	
135	11		2	2.5	
136	11		2	2.8	
137	11		2	3.5	
138	11		2	2.8	
139	11		2	2.7	
140	11		2	2.3	
141	11		2	2.7	
142	11		2	2.3	
143	11		1	3.0	
144	11		2	3.1	
145	11		2	3.3	
146	11		2	2.3	
147	11		2	2.0	

ACCESSION No. (IDENTIFICATION)	EXPERIMENT No.	INOCULUM SOURCE	NUMBER OF PLANTS	SCORE	RANKING
148	11		2	3.3	
152	11		2	2.6	
153	11		2	2.5	
154	11		2	2.8	
156	11		2	2.2	
164	11		2	0.4	R
165	11		2	2.0	
167	11		2	2.6	
168	11		2	1.6	MR
170	11		2	2.8	
171	11		2	2.3	
175	11		2	3.0	
176	11		2	2.7	
177	11		2	3.0	
178	11		2	3.0	
179	11		2	2.1	
183	11		2	2.7	
186	11		2	1.9	MR
187	11		2	3.1	
188	11		2	3.1	
WHEAT	11		4	3.3	
TRITICALE	11		4	3.0	
BARLEY	11		4	2.9	
RYE	11		4	1.2	
4	12	HAREL	5	2.6	
7	12	86	6	3.0	
12	12		7	2.5	
13	12		6	3.0	
14	12		7	3.1	
15	12		6	2.9	
20	12		5	1.9	
21	12		7	2.5	
WHEAT	12		7	2.9	
RYE	12		6	0.8	

ACCESSION No. (IDENTIFICATION)	EXPERIMENT No.	INOCULUM SOURCE	NUMBER OF PLANTS	SCORE	RANKING
243	13	MENACHEM	4	2.3	
244	13		3	1.5	MR
246	13		3	2.2	
247	13		1	2.8	
248	13		4	3.0	
249	13		4	2.3	
251	13		4	3.0	
252	13		3	3.2	
253	13		3	3.0	
254	13		4	2.6	
255	13		4	2.4	
256	13		4	2.4	
257	13		4	2.6	
258	13		3	2.3	
259	13		3	3.1	
260	13		4	2.9	
261	13		4	2.9	
262	13		4	3.0	
263	13		4	2.3	
264	13		1	2.3	
265	13		4	1.8	
266	13		3	1.8	
267	13		4	2.9	
268	13		4	2.3	
269	13		4	1.8	
270	13		4	3.6	
271	13		4	2.1	
272	13		4	3.0	
273	13		3	3.3	
274	13		4	3.1	
275	13		2	2.9	
276	13		2	2.9	
277	13		2	2.3	
278	13		4	2.5	
279	13		4	2.9	

ACCESSION No. (IDENTIFICATION)	EXPERIMENT No.	INOCULUM SOURCE	NUMBER OF PLANTS	SCORE	RANKING
280	13	MENACEM	4	2.4	
281	13		4	1.4	MR
282	13		4	2.0	
283	13		4	2.9	
284	13		4	3.1	
285	13		4	2.3	
286	13		4	3.0	
287	13		4	2.6	
288	13		4	2.7	
290	13		4	2.4	
291	13		4	2.9	
292	13		2	3.3	
293	13		4	2.6	
294	13		4	2.7	
WHEAT	13		5	3.3	
RYE	13		5	0.9	
295	14	MENACHEM	3	2.3	
296	14		4	1.9	
297	14		4	2.3	
298	14		3	2.3	
300	14		4	2.9	
301	14		4	3.0	
302	14		4	2.4	
303	14		4	2.4	
304	14		2	1.9	
305	14		4	2.6	
306	14		3	1.7	
307	14		2	1.8	
308	14		4	2.4	
309	14		2	2.8	
310	14		3	1.4	MR
311	14		4	1.7	
312	14		3	2.4	
313	14		2	2.6	

ACCESSION No. (IDENTIFICATION)	EXPERIMENT No.	INOCULUM SOURCE	NUMBER OF PLANTS	SCORE	RANKING
314	14	MENACHEM	4	1.9	
315	14		4	1.3	MR
315a	14		3	1.4	MR
316	14		4	2.0	
317	14		4	2.2	
318	14		3	2.7	
319	14		4	2.7	
320	14		4	1.8	
321	14		4	2.7	
322	14		4	2.5	
323	14		3	2.7	
324	14		3	2.9	
325	14		4	3.0	
326	14		3	1.4	MR
329	14		3	1.7	
330	14		3	1.8	
331	14		2	2.3	
333	14		2	3.4	
334	14		3	2.5	
WHEAT	14		5	2.8	
RYE	14		5	1.1	
189	15	MENACHEM	4	1.2	
190	15		4	1.8	
191	15		4	1.3	
192	15		4	0.3	R
193	15		4	2.9	
194	15		4	2.2	
195	15		4	1.5	
197	15		4	1.2	
198	15		4	2.3	
199	15		4	1.5	
200	15		4	1.7	
201	15		4	1.2	
202	15		4	0.5	R

ACCESSION No. (IDENTIFICATION)	EXPERIMENT No.	INOCULUM SOURCE	NUMBER OF PLANTS	SCORE	RANKING
204	15	MENACHEM	4	0.3	R
205	15		4	1.0	MR
206	15		4	1.1	
207	15		1	3.3	
208	15		1	2.3	
209	15		4	0.9	MR
210	15		3	1.4	
211	15		4	2.1	
212	15		2	2.1	
213	15		4	1.3	
214	15		3	1.7	
217	15		2	1.2	
218	15		4	0.0	R?
219	15		4	0.0	R?
220	15		4	1.3	
221	15		2	0.7	
222	15		4	1.9	
223	15		4	0.3	
224	15		3	1.3	
225	15		4	2.0	
226	15		4	3.0	
227	15		4	1.5	
228	15		3	0.9	MR
229	15		4	2.1	
230	15		3	2.5	
231	15		3	0.6	MR
232	15		3	0.0	R?
233	15		4	1.0	
234	15		2	1.5	
235	15		3	1.2	
236	15		4	0.0	R?
237	15		4	0.2	R
238	15		2	0.5	MR
239	15		4	1.8	
240	15		3	1.0	

ACCESSION No. (IDENTIFICATION)	EXPERIMENT No.	INOCULUM SOURCE	NUMBER OF PLANTS	SCORE	RANKING
241	15	MENACHEM	3	1.1	
242	15		4	1.4	
WHEAT	15		4	3.2	
TRITICALE	15		5	1.5	
BARLEY	15		4	0.7	
RYE	15		4	0.3	
14-49	17	MENACHEM	2	3.3	
14-46	17		2	3.8	
14-42	17		2	2.8	
14-40	17		3	2.0	MR?
14-35	17		4	3.5	
14-31	17		2	3.8	
14-25	17		2	3.0	
14-22	17		4	3.3	
14-17	17		4	3.2	
14- 2	17		3	4.6	
19-48	17		2	4.3	
19- 7	17		4	3.5	
19-10	17		2	4.0	
19-14	17		3	3.2	
19-35	17		2	3.6	
19-20	17		2	3.9	
19-31	17		2	4.3	
19-37	17		2	2.5	
19-44	17		4	3.4	
32-43	17		4	4.2	
32-47	17		3	3.3	
32-42	17		3	3.8	
32-40	17		3	2.5	
32-38	17		4	2.7	
32-35	17		4	3.4	
32-33	17		1	4.0	
32- 7	17		3	3.5	
32-23	17		3	3.5	

ACCESSION No. (IDENTIFICATION)	EXPERIMENT No.	INOCULUM SOURCE	NUMBER OF PLANTS	SCORE	RANKING
32-22	17		3	3.6	
I- 38	17		4	3.2	
I- 40	17		3	3.6	
I- 16	17		4	3.6	
I- 44	17		4	3.2	
I- 14	17		3	3.1	
I- 28	17		5	3.3	
I- 32	17		3	3.5	
I- 25	17		3	3.6	
I- 22	17		2	3.9	
I- 28	17		4	2.8	
WHEAT	17		5	3.6	
RYE	17		5	3.2	
A- 64	18	MENACHEM	4	2.3	
A- 8	18		4	2.9	
A- 43	18		3	3.5	
A- 21	18		3	2.2	
A- 6	18		3	3.6	
A- 56	18		2	3.6	
A- 51	18		2	3.4	
A- 24	18		3	3.9	
A- 9	18		3	3.2	
A- 80	18		3	3.3	
WHEAT	18		4	3.0	
RYE	18		5	1.9	
B- 19	21	MENACHEM	4	2.9	
B- 15	21		2	2.2	
B- 5	21		3	2.2	
B- 40	21		2	2.5	
B- 8	21		4	2.8	
B- 39	21		3	1.7	R
B- 7	21		3	2.2	
B- 13	21		4	1.6	R

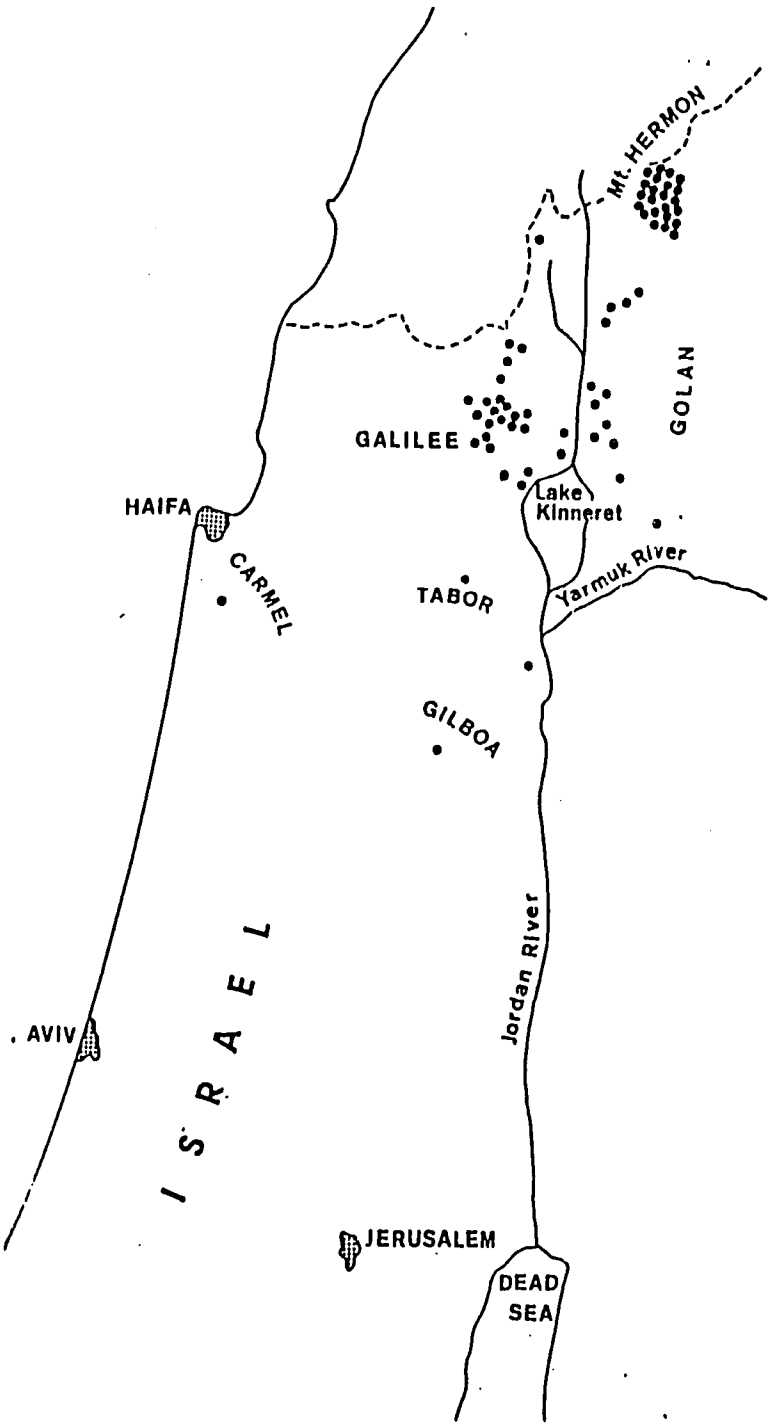
ACCESSION No. (IDENTIFICATION)	EXPERIMENT No.	INOCULUM SOURCE	NUMBER OF PLANTS	SCORE	RANKING
B- 37	21		3	2.3	
B- 32	21		1	1.8	R
C- 45	21		4	3.2	
C- 30	21		4	3.3	
C- 34	21		4	3.5	
C- 29	21		4	3.2	
C- 6	21		4	3.2	
C- 33	21		2	3.3	
C- 69	21		2	3.0	
C- 43	21		2	3.1	
C- 42	21		3	3.1	
C- 70	21		2	3.1	
18- 1	21		3	3.3	
18- 7	21		3	3.3	
18-15	21		2	3.4	
18-20	21		2	3.0	
18-26	21		2	3.4	
18-34	21		4	3.5	
18-38	21		3	3.1	
18-48	21		3	3.3	
18-44	21		1	3.3	
18-58	21		2	3.3	
G- 1	21		2	3.4	
G- 22	21		4	3.0	
G- 20	21		2	2.6	
G- 56	21		2	3.2	
G- 60	21		2	3.1	
G- 37	21		3	3.2	
G- 42	21		2	3.2	
G- 48	21		3	3.0	
G- 61	21		2	2.9	
G- 58	21		2	3.4	
K- 24	21		3	3.4	
K- 50	21		2	3.3	
K- 36	21		2	3.7	

ACCESSION No. (IDENTIFICATION)	EXPERIMENT No.	INOCULUM SOURCE	NUMBER OF PLANTS	SCORE RANKING
K- 41	21		4	3.6
K- 18	21		3	3.4
K- 23	21		4	2.8
K- 45	21		3	3.3
K- 25	21		2	3.5
K- 29	21		4	3.9
K- 46	21		1	3.4
WHEAT	21		6	3.0
RYE	21		5	2.4
B- 5	22	NACHLA	6	1.2
B- 7	22		6	1.2
B- 8	22		6	1.7
B- 13	22		2	1.5
B- 15	22		4	0.7
B- 19	22		6	1.5
B- 32	22		9	1.3
B- 37	22		8	1.4
B- 39	22		8	2.0
B- 40	22		9	1.6
WHEAT	22		10	0.5
BARLEY	22		10	0.1
RYE	22		10	0.0
B- 5	23		7	2.9
B- 8	23		7	3.4
B- 13	23		8	3.2
B- 19	23		9	3.0
B- 32	23		8	3.2
B- 37	23		9	3.0
B- 39	23		3	3.8
B- 40	23		9	2.9
WHEAT	23		10	2.6
BARLEY	23		9	2.3
RYE	23		9	2.4

ACCESSION No. (IDENTIFICATION)	EXPERIMENT No.	INOCULUM SOURCE	NUMBER OF PLANTS	SCORE RANKING
335	24		1	3.5
337	24		1	3.5
339	24		3	3.8
343	24		1	3.4
344	24		1	4.0
345	24		3	3.3
346	24		1	3.3
327	24		4	3.1
328	24		2	3.0
332	24		2	3.0
340	24		3	3.4
326	24		4	3.0
329	24		1	3.0
330	24		2	3.3
331	24		4	3.0
323	24		2	4.0
333	24		4	3.1
334	24		1	3.0
315	24		2	3.0
316	24		2	3.3
317	24		2	3.2
318	24		2	3.0
319	24		3	3.4
320	24		1	1.0
321	24		2	3.3
322	24		2	3.0
324	24		2	3.0
325	24		2	2.9
WHEAT	24		4	3.1
RYE	24		3	2.1
B- 4	25		6	3.2
B- 6	25		8	3.1
B- 9	25		6	3.1
B-12	25		10	2.9

ACCESSION No. (IDENTIFICATION)	EXPERIMENT No.	INOCULUM SOURCE	NUMBER OF PLANTS	SCORE RANKING
B-14	25		6	3.0
B-16	25		9	2.7
B-22	25		8	2.9
B-23	25		6	3.0
B-24	25		5	3.1
B-25	25		7	2.9
WHEAT	25		9	2.8
TRITICALE	25		10	2.5
BARLEY	25		10	1.7
RYE	25		10	1.5
B- 7	26		8	3.2
B-15	26		8	3.0
B-29	26		8	3.4
B-31	26		8	3.4
B-33	26		10	2.9
B-34	26		7	3.5
B-38	26		5	2.4
B-35	26		9	3.4
B-41	26		8	2.5
WHEAT	26		5	3.4
TRITICALE	26		9	2.4
BARLEY	26		10	2.1
RYE	26		10	1.7
295	27		3	2.7
296	27		4	3.2
297	27		4	2.8
298	27		3	3.0
300	27		4	3.5
301	27		2	4.0
302	27		4	2.8
303	27		2	3.0
304	27		1	3.0
305	27		4	2.9

ACCESSION No. (IDENTIFICATION)	EXPERIMENT No.	INOCULUM SOURCE	NUMBER OF PLANTS	SCORE	RANKING
306	27		3	3.0	
307	27		3	3.0	
308	27		2	3.0	
309	27		2	1.5	?
310	27		1	3.0	
311	27		2	2.9	
312	27		2	3.0	
313	27		4	3.0	
314	27		3	3.3	
315	27		2	2.9	
WHEAT	27		4	3.3	
TRITICALE	27		4	2.3	
BARLEY	27		4	2.6	
RYE	27		4	2.4	



• - Population or T. dicoccoides

The geographic distribution area of Triticum dicoccoides collected for "take all" evaluation in the present study.