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January 1979

4-75 Aug.

INTERNATIONAL BEAN RUST NURSERY



Results
1975 ~ 1976



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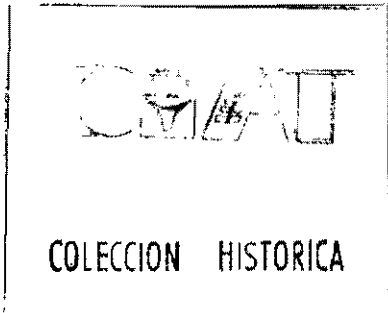
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1975-1976

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INTERNATIONAL BEAN RUST NURSERY

Results 1975-1976



Introduction

Participants in a workshop at the Centro Internacional de Agricultura Tropical (CIAT), in October 1974, considered the establishment of international nurseries to test promising cultivars and breeding lines of *Phaseolus vulgaris* L. for resistance to race populations of the bean rust fungus [*Uromyces appendiculatus* (Pers.) Unger or *U. phaseoli* (Reben) Wint.]. At this workshop, potential collaborators agreed on methodologies to be used, cultivars to be included, and the means of evaluating resistance. CIAT was requested to coordinate the first international bean rust nursery (IBRN).

Objectives

As with other international testing programs coordinated by sister research centers, the objectives of the IBRN's are to:

- (a) Identify cultivars and breeding materials resistant to a wide spectrum of the pathogenic potential inherent in the bean rust fungus;
- (b) Detect new and more virulent rust races before they or bean cultivars susceptible to them become widely disseminated;
- (c) Develop a set of rust differential cultivars to characterize pathogenic variation expressed by the bean rust organism; and,
- (d) Obtain information on race patterns present in bean growing areas.

This publication describes results obtained from the 1975 and 1976 nurseries.

Format of the Nurseries

In 1975, 132 cultivars from Australia, Brazil, Colombia, Costa Rica, Guatemala, Jamaica, Mexico, Peru, Puerto Rico, the United States and CIAT's grain legume germplasm bank were considered for rust evaluation in the different locations. A group of 28 materials was included as potential rust race differentials upon suggestion of scientists from Australia, Brazil, Colombia, Costa Rica, Mexico, Peru and the United States.

Because seed for the 1975 nursery was limited and because planting times used in the nursery overlapped, the same set of basic cultivars was again used in the 1976 nursery. Despite this, only 104 cultivars or less were actually tested by most collaborators.

In 1975, IBRN sets were sent to, and grown by, 10 collaborators in 11 locations in Latin America and the United States. The IBRN had been evaluated at two locations in 1974 and these data are included in the 1975 results. For the 1976 nursery, there were 14 collaborators in 15 locations in Australia, Latin America and the United States. Five of these locations were different from those having tests in 1975. Data from four locations in Latin America were collected early in 1977 and are reported in the 1976 results. One of these four locations did not have a test in either 1975 or 1976. Table 1 lists the locations and collaborators who participated in the trials reported. The geographic distribution of nurseries is presented in Figure 1.

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Figure 1. IBRN test locations in the Western Hemisphere, 1975 and 1976 trials.

Table 1. Test locations and collaborators for the 1975 and 1976 IBRN's.

Location	Collaborators	Computer Code	
		1975	1976
Australia (Castle Hill)	Barbara Ballantyne		AUST
Brazil (Vicosá)	C. Vieira	BRAV	BRAV**
(Goiania)	C. Rava		BRAG & BR77**
Colombia (CIAT, Palmira)	G. Gálvez & J. Galindo	CI74*	
(CIAT, Palmira)	G. Gálvez & J. Galindo (Feb.)	CI02	
(CIAT, Palmira)	G. Gálvez & J. Galindo (Apr.)	CI04	
(CIAT, Palmira)	G. Gálvez & J. Galindo (Oct.)	CI10	
(CIAT, Palmira)	G. Gálvez & P. Guzman		CIAT
Costa Rica (Alajuela)	E. Vargas	CORI	CORI
Dominican Republic (Santiago)	S. Concepción & J. Rodriguez		DORE**
Ecuador (Pallatanga)	J. Delgado & F. Armijos	ECUA	ECUA
El Salvador (Santa Tecla)	R. Villa & V. Rodriguez		ELSA & EL77**
Guatemala (Monjas)	O. Sosa	GUAT	
(Chimaltenango)	R. Cojulun		GUAT
Mexico (Celaya, Gto.)	J. Martinez		MEXC
Peru (La Molina)	S. Dongo	PE74* & PERU	
(La Molina)	S. Dongo & Norma Salas		PERU
Puerto Rico (Isabela)	N. Vakili	PURI	PURI
(Limani)	N. Vakili	PURL	PURL
United States (Beltsville, Md.)	J. Meiners	USAB	USAB
(Fargo, N.D.)	E. Lloyd	USAF	
(E. Lansing, Mich.)	A.W. Saettler	USAM	USAM

* Actually tested in late 1974.

** Actually tested in early 1977.

Management of the Nurseries

The suggested procedures for the 1975 and 1976 rust nurseries followed closely the system used at CIAT for evaluating rust resistance in germplasm lines. Fertilizer applications followed local recommendations and were designed to allow normal plant development free of nutrient deficiency problems.

The recommended planting pattern is shown in Figure 2. Mixtures of two to five susceptible cultivars were sown as border/spreader rows around the plot 25 days before planting nursery sets. IBRN entries were sown in rows perpendicular to border rows, with rows spaced 60 centimeters apart and 30 seeds per two-meter rows. A susceptible local cultivar was sown every third row, and a local resistant cultivar or selection sown after every 10 IBRN entries. Sufficient seed was provided to plant two replications, if desired. Recommendations were available on appropriate times to plant the IBRN at each location.

Disease Reaction Classification

Evaluation of the entries for rust resistance 30 and 45 days after planting considered two criteria:

- (a) Intensity of infection, expressed as the percentage of leaf area covered by necrotic spots or sporulating pustules; and,
- (b) Type of pustule, with five classes of development. These are:
 1. Immune: no evidence of infection.
 2. Resistant: necrotic spots without sporulation.
 3. Moderately resistant: pustules formed but of a diameter less than 300 μ .
 4. Moderately susceptible: pustules formed having diameters of 300 to 500 μ .

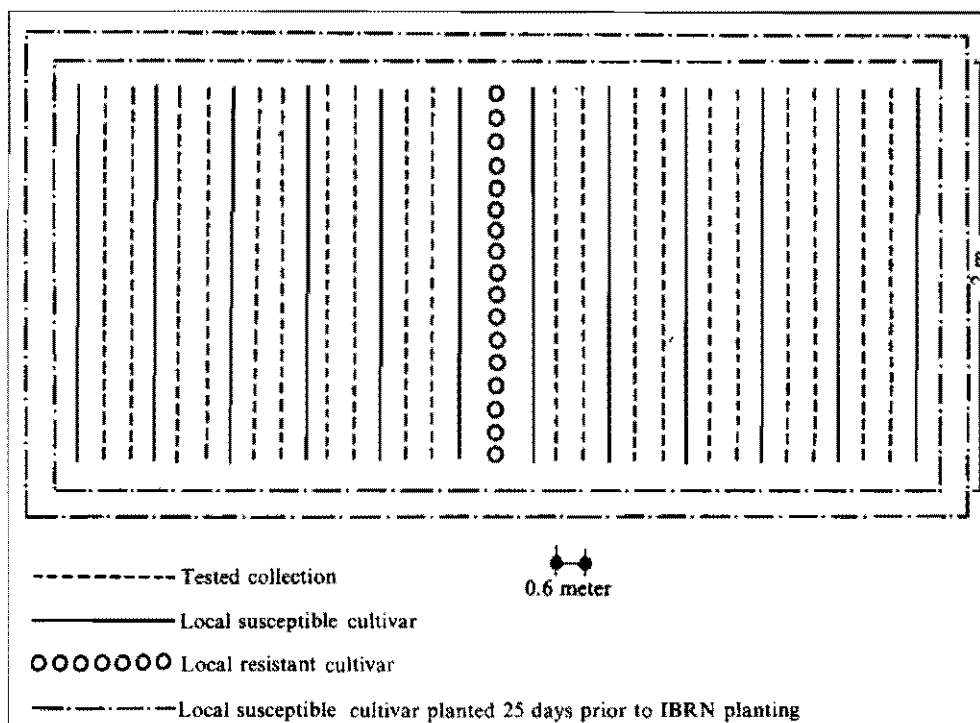


Figure 2. Recommended planting pattern for IBRN trials.

- Susceptible: pustules formed having diameters greater than 500 μ and often surrounded by chlorotic halos.

Data obtained from collaborators were processed with a computer by compounding intensity and pustule type with time of note taking (see Table 2). Four categories of plant reaction were then defined, according to the tableau in Figure 3. (In locations where two replicates were planted, the higher final rust rating was used to tabulate results.) Data for each location in 1975 and 1976 are presented in Table 3. Table 4 summarizes plant reactions recorded for each entry in 1975 and 1976.

Results

No cultivar or breeding material was immune or resistant at every IBRN location in both years (see Tables 3 and 4). However, some entries were at least resistant or intermediate for their plant reaction at many locations in both years (Table 5). Other entries such as Mexico 235, SB-30-CI-PM-PI, Redlands Greenleaf B. and C, Redlands Pioneer and Redlands Autumn Crop were only susceptible at two locations in

Table 2. Method for final classification of IBRN entries.

Classification 30 days after planting	Classification 45 days after planting	Final classification
1*	1	1
1	2	2
1	3	3
1	4	4
2	1	2
2	2	2
2	3	3
2	4	4
3	1	3
3	2	2
3	3	3
3	4	4
4	1	3
4	2	2
4	3	3
4	4	4

* Classification values obtained from Figure 3 1 = immune; 2 = resistant; 3 = intermediate; 4 = susceptible.

Immune 1	Resistant 2					
1—0%						
2—1%	2—5%	2—10%	2—30%	2—40%	2—65%	2—100%
3—1%	3—5%	3—10%	3—30%	3—40%	3—65%	3—100%
4—1%	4—5%	4—10%	4—30%	4—40%	4—65%	4—100%
5—1%	5—5%	5—10%	5—30%	5—40%	5—65%	5—100%
Intermediate 3			Susceptible 4			

Figure 3. Plant reaction classification determined by field observations of rust infection type and intensity. The number is a rating of the pustule size on a scale of 1-5 with the infection intensity given as a percentage.

1976, but were not tested at a sufficient number of locations in 1975 for an overall evaluation.

Of the resistant or intermediate entries mentioned above, Ecuador 299, PR-5, Mexico 309 and Turrialba 1, have been used as sources of rust resistance in the CIAT breeding program. These cultivars were resistant or immune at most IBRN locations (Table 5).

Of the locations having tests (Table 6), CIAT in 1975, and the Dominican Republic, Costa Rica, CIAT and Mexico in 1976 had the highest proportion of susceptible entries. These should be excellent locations to test hybrid materials for resistance to a diverse population of rust races.

Insufficient data were obtained in 1975 and 1976 to effectively evaluate rust populations or rust differentials used in these trials. The rust fungus obviously possessed a diverse pathogenic potential, as evidenced

by location specificities and time of planting differences.

Pinto 650, tested in 32 trials during the two-year period, proved susceptible in 28, intermediate in 3, and resistant in only 1. The resistant and intermediate reactions occurred during a very light epidemic. While further testing of this cultivar is needed, it could be useful as a potential universal susceptible cultivar for bean rust studies.

The 1975 and 1976 IBRN's demonstrated that bean researchers could collaborate effectively in the evaluation of bean germplasm for resistance to the rust fungus. More germplasm must be evaluated to identify widely resistant materials and breeding strategies should be designed to utilize existing sources of less widely adapted resistance most effectively. Because of experiences gained in 1975 and 1976, modification of the IBRN will be discussed with collaborators in the near future.

Table 3. Final plant classifications for IBRN entries in 1975 and 1976 IBRN's. (1= immune; 2= resistant; 3= intermediate; 4 = susceptible; 0 = no data)

IBRN Entry No.	Identification	1975 IBRN Location and Reaction														
		CI74	PE74	BRV	CI02	CI04	CI10	CORI	ECUA	GUAT	PERU	PURI	PURL	USAB	USAF	USAM
1.	4691-54-1	0	0	3	2	3	4	2	2	1	0	3	4	2	0	0
2.	Redlands Pioneer	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3.	11411	0	0	3	3	1	3	3	2	2	1	3	4	2	0	0
4.	California Small White 643	0	0	0	0	0	0	3	0	1	1	0	0	2	0	0
5.	27-R	2	4	2	1	2	3	3	4	1	3	3	3	4	0	0
6.	Diacol Calima	3	0	3	3	2	2	1	2	1	1	2	1	2	0	0
7.	Compuesto Chimaltenango 3	2	0	1	1	1	4	3	2	1	0	3	0	2	0	0
8.	SB-30-CI-PM-PI	0	0	0	2	0	4	0	0	0	0	0	0	0	0	0
9.	Cuilapa 72	2	0	2	1	1	2	3	2	2	1	2	1	2	0	0
10.	PR 12	3	0	3	3	3	1	3	4	1	4	1	3	4	0	0
11.	PR 19	3	0	3	2	1	3	2	0	1	1	3	1	3	0	0
12.	VI 1013	0	0	0	2	1	2	0	0	0	0	0	0	1	0	0
13.	Mexico 309	2	0	2	1	1	2	3	2	1	1	2	1	1	0	0
14.	Turrialba 1	4	0	1	2	1	3	3	2	1	1	4	4	2	0	0
15.	ICA-Guali	3	0	3	1	2	3	1	3	1	4	2	1	3	0	0
16.	Villa Guerrero	0	0	0	3	3	4	0	0	0	0	0	0	2	1	1
17.	Negro Jalpatagua	4	0	2	2	2	2	3	2	1	1	4	4	1	0	0
18.	San Pedro Pinula	4	0	1	2	3	2	3	2	1	1	4	3	1	0	0
19.	Turrialba 4	2	0	1	1	1	4	3	2	2	1	2	1	2	1	1
20.	Westralia	4	0	0	0	4	3	0	3	0	0	0	0	3	0	0
21.	P.I. 319649	3	1	1	2	1	1	3	2	2	1	4	4	3	2	1
22.	Porrillo 1	4	0	3	2	3	3	3	2	3	1	3	3	3	1	2
23.	Rico Pardo 896	2	0	2	1	1	2	1	2	2	0	4	3	2	0	0
24.	Wisc. Hyb. 72	0	0	0	0	0	1	0	0	0	0	0	0	2	0	0
25.	Linea 37	0	0	1	2	1	2	3	2	2	1	2	1	2	0	0
26.	Ecuador 299	2	0	2	2	2	3	1	2	2	1	1	1	2	0	1
27.	Porrillo 70	4	0	3	3	3	4	3	2	1	1	4	2	3	0	0
28.	142-ML-PM-PI	0	0	0	3	0	3	0	0	0	0	0	0	0	0	0
29.	ICA-Tui	4	0	3	4	3	4	3	2	2	1	3	4	1	1	1
30.	Canario Divex 8120	0	0	3	2	2	3	1	3	1	4	3	2	3	2	2
31.	Cocacho	0	0	2	0	1	2	4	2	1	1	2	0	1	0	1
32.	Venezuela 54	0	0	0	3	0	4	0	0	0	0	0	0	2	1	0
33.	PR 5	2	0	3	2	1	2	3	2	1	2	3	1	2	1	0
34.	Compuesto Chimaltenango 2	2	0	1	1	1	1	1	2	1	1	1	1	2	0	0
35.	Porrillo Sintetico	4	0	3	3	4	3	1	2	2	1	3	3	3	0	0

1976 IBRN Location and Reaction

AUST	BRAG	CIAT	CORI	ECUA	ELSA	GUAT	MEXC	PERU	PURI	PURL	USAB	USAM	BRAY	BR77	DORE	EL77
3	4	4	4	3	1	2	3	1	4	3	2	3	3	4	2	3
3	0	1	2	3	3	2	3	1	2	4	2	2	3	2	4	2
1	4	2	4	3	2	4	3	1	3	4	2	2	3	3	1	2
3	2	0	0	0	0	0	4	0	0	0	2	1	0	0	0	0
3	4	1	2	4	2	2	4	4	3	0	4	2	3	4	4	2
3	4	2	2	3	2	2	4	1	2	2	3	2	3	4	4	2
1	2	1	2	2	2	3	4	1	2	1	2	2	2	3	1	2
1	0	2	3	4	2	3	4	1	3	3	2	1	2	2	3	2
1	4	2	4	3	1	4	1	1	1	1	2	1	1	3	3	2
3	2	2	2	4	3	2	4	4	2	2	4	2	3	2	3	2
1	4	1	3	3	3	4	4	1	2	3	2	2	2	3	1	2
1	0	2	0	0	0	3	4	0	0	0	2	1	0	0	0	0
1	2	1	4	3	4	3	1	1	1	1	2	2	1	2	1	3
1	2	1	3	3	3	2	4	2	2	3	2	1	2	3	3	2
3	4	1	2	4	2	2	3	4	2	2	3	2	3	3	3	2
1	0	4	3	4	3	3	4	1	2	4	2	1	4	4	4	3
1	2	1	4	0	3	3	4	1	4	4	2	1	2	2	1	2
1	2	2	3	2	3	3	4	1	3	4	2	1	1	2	3	2
1	3	1	4	4	3	2	4	1	1	1	2	1	1	3	3	2
1	0	3	4	4	4	4	4	1	4	4	4	2	3	4	4	3
1	2	2	4	3	4	4	4	1	2	4	2	2	1	2	4	2
1	4	4	4	3	3	3	4	1	3	4	3	2	3	4	4	2
1	2	2	3	3	4	4	4	1	3	3	1	1	2	2	1	2
3	0	0	0	0	0	0	4	0	0	0	3	2	0	0	0	0
1	4	2	3	2	4	4	4	1	2	3	2	3	1	4	1	2
1	3	4	3	2	3	3	4	1	2	2	2	1	2	3	3	2
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3	4	4	0	4	0	0	4	0	0	0	4	2	0	4	0	2
3	4	2	0	2	0	0	4	0	0	0	2	2	0	3	0	2
1	0	4	4	3	2	3	4	2	3	4	2	1	4	4	4	2
1	4	1	4	2	3	3	4	1	3	2	2	1	2	3	3	2
1	3	1	2	4	4	4	4	1	1	3	2	1	1	1	4	2
3	3	4	4	3	3	2	4	1	3	4	3	2	3	3	4	2

Table 3. Continued

IBRN Entry No.	Identification	1975 IBRN Location and Reaction														
		CI74	PE74	BRAV	CI02	CI04	CI10	CORI	ECUA	GUAT	PERU	PURI	PURL	USAB	USAF	USAM
36.	173-ML-PM-PI	0	0	0	3	0	3	0	0	0	0	0	0	0	0	0
37.	P.I. 313667	2	4	3	1	1	2	3	0	1	4	2	3	4	0	0
38.	PR 4	0	0	4	3	4	4	3	2	2	1	4	0	2	1	0
39.	PR 9	0	0	4	3	4	4	3	0	1	0	3	4	2	1	0
40.	PR 3	0	0	3	3	4	4	3	2	2	0	4	0	1	1	1
41.	Linea 34	0	0	3	3	1	2	1	2	2	1	4	4	2	0	0
42.	PR 1	0	0	1	3	3	3	2	2	2	1	4	4	2	1	1
43.	G.N. Tara	3	0	2	0	1	2	1	0	1	1	4	3	4	3	3
44.	Cornell 49-242	3	0	3	2	2	4	3	0	2	1	2	3	2	1	1
45.	Negro San Ramón No. 5	0	0	3	3	1	1	1	4	1	1	2	1	2	0	0
46.	PR 21	0	0	4	2	4	4	2	3	0	1	3	3	0	0	0
47.	PR 17	3	0	4	3	3	4	1	3	1	1	2	2	2	0	0
48.	P.I. 163372	4	0	3	3	2	4	2	0	1	1	3	4	1	2	2
49.	Nep 2	4	0	3	2	0	3	2	2	2	1	3	3	1	0	1
50.	Diacol Nima	3	0	3	3	4	3	1	4	1	4	1	3	0	1	0
51.	P.I. 165426 (Black-seeded)	4	0	4	3	2	4	3	2	3	1	4	3	2	1	1
52.	ICA-Pijao	0	0	1	3	3	4	2	3	1	1	4	4	3	0	0
53.	Rico 23	4	0	4	2	3	4	3	3	1	1	3	3	2	0	0
54.	P.I. 199044	2	4	3	2	1	3	1	0	1	4	1	4	4	0	1
55.	Rico Baio 1014	0	0	0	0	1	3	0	2	0	0	0	0	0	0	0
56.	P.I. 313664	3	4	2	3	2	3	1	0	1	4	1	4	1	1	1
57.	P.I. 165426 (White-seeded)	4	0	3	3	3	4	3	2	2	1	4	4	2	1	1
58.	Jamapa	4	0	2	1	3	3	0	2	2	1	4	4	2	1	2
59.	P.I. 203958	0	0	3	2	3	3	3	0	1	1	3	4	4	3	2
60.	P.I. 226883	3	4	3	2	2	3	1	0	1	4	3	3	4	0	0
61.	P.I. 152326	0	0	4	3	3	4	3	0	3	0	3	4	1	3	1
62.	P.I. 307824	0	0	3	2	4	4	3	0	2	1	4	4	3	1	1
63.	P.I. 226895	0	0	2	2	1	3	1	0	2	1	2	2	3	1	2
64.	Actopan x Sanilac 37	0	0	0	3	0	3	0	0	0	0	0	0	1	0	0
65.	Actopan x Sanilac 39	0	0	0	3	0	2	0	0	0	0	0	0	0	0	0
66.	Actopan x Sanilac 51	0	0	0	2	0	3	0	0	0	0	0	0	0	0	0
67.	Amarillo de Andahuaylas	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
68.	Aurora	4	0	0	3	4	4	0	2	0	0	0	0	2	1	1
69.	Bayo Camana	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0
70.	Bonita	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0
71.	Bush Romano 14	0	0	0	3	0	0	0	0	0	0	0	0	3	1	1
72.	Caballero	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0
73.	Cacahuete 72	0	0	0	2	0	3	0	0	0	0	0	0	4	0	0
74.	Canario L. M.	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
75.	Compuesto Cotaxtla	0	0	0	0	0	4	0	0	0	0	0	0	3	0	0

1976 IBRN Location and Reaction

AUST	BRAG	CIAT	CORI	ECUA	ELSA	GUAT	MEXC	PERU	PURI	PURL	USAB	USAM	BRAY	BR77	DORE	EL77
1	0	3	4	4	4	4	4	1	2	4	3	2	3	3	4	3
3	4	1	3	4	3	2	4	4	2	3	3	2	3	3	4	3
1	4	4	4	4	3	3	4	1	3	4	1	1	3	4	4	2
1	4	4	4	4	3	3	4	1	4	4	2	2	4	4	4	2
1	4	3	4	3	3	3	4	1	4	4	2	2	3	4	4	2
1	4	2	4	3	4	3	4	1	4	4	3	4	3	4	4	2
1	4	2	3	3	3	2	4	1	2	4	2	2	3	2	1	2
4	2	3	3	3	3	2	4	1	2	2	4	4	1	0	4	0
1	4	2	3	3	3	3	4	1	3	3	2	2	3	3	3	2
3	0	1	4	4	3	4	4	1	4	2	3	2	3	3	1	4
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1	3	4	4	3	3	4	3	1	3	4	2	1	3	3	4	2
3	4	2	2	4	3	2	3	4	2	2	3	2	3	3	1	2
4	3	4	4	4	3	4	0	1	4	4	2	1	3	4	4	3
3	2	4	2	3	2	2	1	1	3	3	3	3	2	1	3	2
3	4	4	4	3	3	3	0	1	3	4	1	1	4	4	4	2
3	2	3	1	4	2	2	0	4	2	3	4	2	3	3	3	4
1	0	3	2	2	3	4	1	1	2	3	4	1	1	3	3	4
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1	4	4	4	3	3	3	4	1	3	3	2	2	4	4	4	2
3	4	4	3	3	4	4	0	1	2	4	3	2	3	3	4	2
3	0	3	3	4	3	3	3	4	2	4	4	1	3	3	4	4
1	4	4	4	4	3	4	4	1	4	4	1	1	3	4	4	3
3	4	4	4	4	3	4	4	1	4	4	1	3	4	4	4	3
3	3	2	4	3	3	2	4	1	2	3	3	2	2	0	3	0
1	0	4	4	2	3	4	4	1	4	4	2	2	2	2	4	2
1	0	4	4	3	3	3	3	1	3	4	2	2	2	2	3	3
1	0	3	4	2	3	4	3	1	4	4	2	1	1	2	1	3
0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0
1	0	4	4	4	4	4	4	1	3	4	2	2	3	3	4	2
3	0	1	0	0	0	0	0	0	0	0	3	2	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	2	2	0	4	0	2
3	0	4	4	4	3	3	1	4	2	3	3	2	3	3	0	4
3	0	3	0	0	0	0	0	0	0	0	3	2	0	3	2	2
3	0	2	3	4	2	2	3	4	2	3	3	2	2	3	4	2
1	0	0	0	0	0	0	0	0	0	0	3	2	0	0	0	0
3	0	4	4	4	3	4	4	1	4	4	3	2	3	4	4	2

Table 3. Continued

IBRN Entry No.	Identification	1975 IBRN Location and Reaction													
		CI74	PE74	BRV	CI02	CI04	CI10	CORI	ECUA	GUAT	PERU	PURI	PURL	USAB	USAF
76.	Costa Rica 1031	0	0	0	0	2	3	0	2	0	0	0	2	0	0
77.	Guatemala 416	0	0	0	3	0	4	0	0	0	0	0	2	3	2
78.	Honduras 46	0	0	0	3	2	4	0	3	0	0	0	2	0	0
79.	La Vega	0	0	0	0	1	3	0	0	0	0	0	2	1	1
80.	Manteigao Preto 20	0	0	0	1	3	3	0	0	0	0	0	2	0	0
81.	Mexico 142-N	0	0	0	3	0	3	0	0	0	0	0	2	0	1
82.	Mexico 235	0	0	0	3	1	3	0	0	0	0	0	2	0	1
83.	Miss Kelly	0	0	0	2	3	4	0	0	0	0	0	1	0	0
84.	Mogul	3	2	0	3	1	3	0	1	0	0	0	2	0	0
85.	Mountaineer White Half Runner	4	0	0	0	3	2	0	2	0	0	0	4	3	2
86.	Negro de Chincha	0	0	0	0	0	0	0	0	0	0	0	0	0	0
87.	Ormiston	0	0	0	0	0	2	0	0	0	0	0	4	1	1
88.	Panamito Corriente	0	0	0	0	3	4	0	0	0	0	0	1	0	0
89.	Pinto Serrano	0	0	0	0	0	0	0	0	0	0	0	0	0	0
90.	P.I. 165435	0	0	0	3	3	4	0	0	0	0	0	2	1	2
91.	P.I. 207262	0	0	0	0	2	4	0	0	0	0	0	3	0	0
92.	P.I. 310739	0	0	0	3	3	3	0	0	0	0	0	2	3	1
93.	P.I. 310814	0	0	0	3	0	4	0	0	0	0	0	4	3	3
94.	P.I. 310878	0	0	0	2	3	4	0	0	0	0	0	3	3	1
95.	P.I. 313524	0	0	0	3	1	3	0	0	0	0	0	2	0	1
96.	Plomo	0	0	0	0	0	0	0	0	0	0	0	0	0	0
97.	Portland Red	0	0	0	4	4	4	0	0	0	0	0	4	0	0
98.	Portugal	0	0	0	1	1	4	0	0	0	0	0	2	0	0
99.	Preto 897	0	0	0	3	3	4	0	2	0	0	0	1	0	0
100.	PR 2	0	0	0	3	0	4	0	0	0	0	0	1	1	1
101.	PR 6	2	0	0	3	1	2	0	3	0	0	0	2	1	1
102.	PR 7	0	0	0	0	0	4	0	0	0	0	0	3	0	0
103.	PR 15	0	0	0	2	3	3	0	4	0	0	0	4	0	0
104.	PR 18	0	0	0	1	1	3	0	4	0	0	0	0	0	0
105.	Redlands Autumn Crop	0	0	0	0	0	2	0	0	0	0	0	3	1	1
106.	Redlands Green Leaf C	0	0	0	3	0	2	0	0	0	0	0	3	1	2
107.	Cuva 168-N	0	0	2	2	2	3	1	1	1	0	4	4	2	1
108.	Redlands Green Leaf B	2	0	3	2	1	0	3	0	1	1	1	2	1	1
109.	Bountiful 181	2	4	3	3	2	3	2	4	1	4	2	4	4	1
110.	Brown Beauty	2	0	0	0	0	4	0	4	0	0	0	4	3	1
111.	Canario 101	2	0	3	2	3	0	1	0	1	4	1	4	4	1
112.	California Small White 643	2	4	3	2	1	2	0	0	0	0	2	3	2	1
113.	C. C. G. B. 44	3	0	0	0	4	0	0	0	0	0	0	2	1	1
114.	Dade	0	0	0	0	0	2	0	0	0	0	0	2	0	2
115.	Epicure	4	0	0	0	0	0	0	0	0	0	0	4	0	3

1976 IBRN Location and Reaction

AUST	BRAG	CIAT	CORI	ECUA	ELSA	GUAT	MEXC	PERU	PURI	PURL	USAB	USAM	BRBV	BR77	DORE	EL77
1	0	4	3	3	2	3	3	1	4	3	1	1	2	2	4	3
1	0	4	4	4	4	4	4	1	4	4	3	2	3	4	4	3
3	0	4	4	4	4	4	4	1	4	4	3	3	3	4	4	2
1	0	2	4	3	4	4	4	1	4	3	2	1	2	2	3	3
3	0	2	2	4	3	2	4	4	2	3	4	2	3	3	3	2
1	0	4	0	0	0	0	4	0	0	0	3	1	0	3	0	3
1	0	3	2	2	3	4	4	1	1	2	1	1	2	3	1	3
3	0	4	4	4	3	4	4	1	3	3	2	1	3	4	4	3
3	0	4	4	3	3	4	4	1	2	3	3	2	3	4	4	3
3	0	4	3	4	3	2	4	2	4	3	4	3	3	3	4	3
1	0	3	0	0	0	0	0	0	0	0	3	2	0	3	0	2
3	0	1	0	0	0	0	3	0	0	0	3	1	0	0	0	0
1	0	3	4	3	3	3	4	1	3	4	3	1	3	3	4	2
1	0	3	0	0	0	0	0	0	0	0	1	1	0	3	0	2
1	0	4	4	3	4	4	4	1	3	4	4	1	3	3	4	3
1	0	4	4	4	3	4	4	4	4	4	4	2	3	4	4	3
1	0	4	4	4	3	4	4	1	3	3	4	2	3	4	4	2
3	0	4	4	4	4	4	4	1	3	4	4	3	3	4	4	3
1	0	4	4	4	3	4	4	1	3	4	2	2	3	4	4	3
1	0	4	3	3	3	3	4	1	1	3	2	1	3	2	4	3
0	0	0	0	0	0	0	0	0	0	0	2	2	0	0	0	0
3	0	4	4	4	4	4	4	1	4	4	4	3	3	4	4	3
3	0	1	3	3	2	2	4	4	2	3	2	2	3	0	1	0
1	0	4	4	3	3	3	4	1	3	4	1	1	3	3	4	2
3	0	4	0	0	0	0	4	0	0	0	1	2	0	4	0	3
1	0	1	4	4	4	4	4	1	4	3	2	2	2	2	2	3
1	0	4	0	0	0	0	0	0	0	0	3	1	0	4	0	3
3	0	1	2	4	2	2	4	4	2	4	3	2	2	3	4	3
3	0	2	2	4	3	2	4	3	4	3	3	2	3	3	4	2
3	0	2	2	4	2	2	3	4	2	2	3	2	2	3	3	2
3	0	3	2	3	2	2	4	2	3	3	2	1	3	2	4	2
1	2	3	4	0	2	3	4	1	4	4	1	1	3	2	1	2
3	1	3	2	3	2	2	4	1	3	3	2	2	2	2	4	2
3	2	3	2	4	2	2	4	4	3	3	4	2	3	3	4	2
3	0	3	3	4	3	2	4	4	3	3	4	2	3	3	4	3
4	2	2	2	4	2	2	3	4	2	3	4	2	3	2	2	3
3	0	4	2	3	3	2	4	1	2	2	3	1	3	2	4	2
3	0	4	3	3	3	3	4	1	4	4	1	1	4	4	4	2
4	0	4	0	0	0	0	0	0	0	0	4	2	0	0	0	0
4	0	4	4	4	4	4	4	1	4	4	4	3	3	4	4	4

Table 3. Continued

IBRN Entry No.	Identification	1975 IBRN Location and Reaction														
		CI74	PE74	BRV	CI02	CI04	CI10	CORI	ECUA	GUAT	PERU	PURI	PURL	USAB	USAF	USAM
116.	Golden Gate Wax	3	2	3	3	3	4	3	0	1	4	3	3	2	1	2
117.	Kentucky Wonder 765	2	4	2	2	1	4	1	0	1	1	3	2	2	2	2
118.	Kentucky Wonder 780	4	2	4	3	4	4	3	0	2	2	3	4	4	3	2
119.	Kentucky Wonder 814	2	2	2	3	2	4	3	0	1	1	4	3	3	2	2
120.	Mulatinho	3	0	0	0	0	4	0	0	0	0	0	0	3	0	1
121.	Pinto No. 650	4	4	4	4	4	4	4	3	2	4	4	4	4	3	3
122.	U. S. No. 3	4	4	3	4	4	4	4	0	2	1	0	4	4	3	3
123.	Veracruz 1A6	2	0	0	0	2	0	0	0	0	0	0	0	3	3	2
124.	Aguascalientes 13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
125.	Guerrero 6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
126.	Guerrero 9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
127.	Guanajuato 10-A-5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
128.	Jalisco 33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
129.	Mexico 6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
130.	Mexico 12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
131.	Negro 150	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
132.	Veracruz 10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

1976 IBRN Location and Reaction

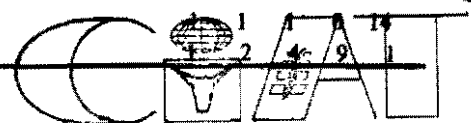
AUST	BRAG	CIAT	CORI	ECUA	ELSA	GUAT	MEXC	PERU	PURI	PURL	USAB	USAM	BRAY	BR77	DORE	EL77
4	4	4	4	4	3	2	3	1	3	3	3	1	0	3	4	4
4	2	2	3	3	3	4	0	1	3	2	3	2	2	3	4	3
4	3	4	3	4	3	3	1	2	4	4	4	3	3	3	2	3
1	2	4	4	3	4	2	4	1	4	3	3	3	3	3	4	4
1	0	4	4	4	4	3	0	1	4	4	2	1	4	4	4	2
4	4	4	4	4	4	4	0	4	4	4	4	4	4	4	4	4
4	4	4	4	4	4	4	4	1	4	4	4	3	0	4	4	3
4	0	3	4	3	3	3	4	1	4	4	3	3	3	3	4	3
0	0	4	0	0	0	0	3	0	0	0	4	3	0	4	0	4
0	0	3	0	0	0	0	3	0	0	0	2	1	0	3	0	3
0	0	4	0	0	0	0	4	0	0	0	4	3	0	4	0	3
0	0	4	0	0	0	0	4	0	0	0	3	2	0	3	0	4
0	0	2	0	0	0	0	4	0	0	0	3	0	0	0	0	0
0	0	2	0	0	0	0	3	0	0	0	3	1	0	2	0	4
0	0	4	0	0	0	0	4	0	0	0	3	3	0	4	0	2
0	0	4	0	0	0	0	1	0	0	0	3	2	0	0	0	0
0	0	4	0	0	0	0	2	0	0	0	4	3	0	3	0	3

Table 4. Summary of plant classifications for each IBRN entry during 1975 and 1976 IBRN's.

IBRN Entry No.	Identification	No. of locations where the entry was classified as:									
		1975					1976				
		Immune	Resistant	Intermediate	Susceptible	No data	Immune	Resistant	Intermediate	Susceptible	No data
1.	4691-54-1	1	4	3	2	5	2	3	7	5	0
2.	Redlands Pioneer	0	0	0	0	15	2	7	5	2	1
3.	11411	2	3	5	1	4	3	5	5	4	0
4.	California Small White 643	2	1	1	0	11	1	2	1	1	12
5.	27-R	2	3	5	3	2	1	5	3	7	1
6.	Diacol Calima	4	5	3	0	3	1	8	4	4	0
7.	Compuesto Chimaltenango 3	4	3	2	1	5	5	9	2	1	0
8.	SB-30-CI-PM-PI	0	1	0	1	13	3	6	5	2	1
9.	Cuilapa 72	4	7	1	0	3	8	3	3	3	0
10.	PR 12	3	0	6	3	3	0	9	4	4	0
11.	PR 19	4	2	5	0	4	4	5	5	3	0
12.	VI 1013	2	2	0	0	11	2	2	1	1	11
13.	Mexico 309	6	5	1	0	3	8	4	3	2	0
14.	Turrialba 1	4	3	2	3	3	3	7	6	1	0
15.	ICA-Guali	4	2	5	1	3	1	7	6	3	0
16.	Villa Guerrero	2	1	2	1	9	3	2	4	7	1
17.	Negro Jalpatagua	3	5	1	3	3	5	5	2	4	1
18.	San Pedro Pinula	4	3	3	2	3	4	6	5	2	0
19.	Turrialba 4	7	5	1	1	1	7	3	4	3	0
20.	Westralia	0	0	3	2	10	2	1	3	10	1
21.	P.I. 319649	6	4	3	2	0	3	7	1	6	0
22.	Porrillo 1	2	3	8	1	1	2	2	6	7	0
23.	Rico Pardo 896	3	6	1	1	4	5	5	4	3	0
24.	Wisc. Hyb. 72	1	1	0	0	13	0	1	2	1	13
25.	Linea 37	4	6	1	0	4	4	5	3	5	0
26.	Ecuador 299	5	7	1	0	2	3	6	6	2	0
27.	Porrillo 70	2	2	5	3	3	1	5	6	5	0
28.	142-ML-PM-PI	0	0	2	0	13	3	3	5	5	1
29.	ICA-Tui	4	2	4	4	1	3	2	4	8	0
30.	Canario Divex 8120	2	5	5	1	2	0	2	1	6	8
31.	Cocacho	5	4	0	1	5	0	5	2	2	8
32.	Venezuela 54	1	1	1	1	11	2	4	3	7	1
33.	PR 5	4	6	3	0	2	4	5	5	3	0
34.	Compuesto Chimaltenango 2	9	3	0	0	3	7	3	2	5	0
35.	Porrillo Sintetico	2	2	6	2	3	1	3	8	5	0

Table 4. Continued

IBRN Entry No.	Identification	No. of locations where the entry was classified as:									
		1975					1976				
		Immune	Resistant	Intermediate	Susceptible	No data	Immune	Resistant	Intermediate	Susceptible	No data
36.	173-ML-PM-PI	0	0	2	0	13	2	2	5	7	1
37.	P.I. 313667	3	3	3	3	3	1	3	8	5	0
38.	PR 4	2	3	2	4	4	4	1	4	8	0
39.	PR 9	2	1	3	4	5	2	3	2	10	0
40.	PR 3	3	2	3	3	4	2	3	5	7	0
41.	Linea 34	3	4	2	2	4	2	2	4	9	0
42.	PR 1	4	4	3	2	2	3	7	4	3	0
43.	G.N. Tara	4	2	4	2	3	2	4	4	5	2
44.	Cornell 49-242	3	5	4	1	2	2	4	9	2	0
45.	Negro San Ramón No. 5	6	2	2	1	4	3	2	5	6	1
46.	PR 21	1	2	3	3	6	2	2	6	7	0
47.	PR 17	3	3	4	2	3	2	2	4	8	1
48.	P.I. 163372	3	4	3	3	2	4	3	2	8	0
49.	Nep 2	3	4	4	1	3	3	2	7	5	0
50.	Diacol Nima	4	0	5	3	3	1	7	6	3	0
51.	P.I. 165426 (Black-seeded)	3	3	4	4	1	3	1	4	8	1
52.	ICA-Pijao	3	1	4	3	4	3	6	7	1	0
53.	Rico 23	2	2	5	3	3	3	1	5	7	1
54.	P.I. 199044	5	2	2	4	2	1	5	6	4	1
55.	Rico Baio 1014	1	1	1	0	12	5	3	5	3	1
56.	P.I. 313664	6	2	3	3	1	3	4	7	3	0
57.	P.I. 165426 (White-seeded)	3	3	4	4	1	3	1	4	9	0
58.	Jamapa	3	5	2	3	2	2	3	5	7	0
59.	P.I. 203958	2	2	6	2	3	1	3	6	6	1
60.	P.I. 226883	2	2	5	3	3	1	1	8	6	1
61.	P.I. 152326	2	0	6	3	4	4	0	3	10	0
62.	P.I. 307824	3	2	3	4	3	2	0	4	11	0
63.	P.I. 226895	4	6	2	0	3	1	5	7	2	2
64.	Actopan x Sanilac 37	1	0	2	0	12	2	6	1	7	1
65.	Actopan x Sanilac 39	0	1	1	0	13	2	4	7	3	1
66.	Actopan x Sanilac 51	0	1	1	0	13	5	3	4	4	1
67.	Amarillo de Andahuaylas	0	0	0	0	15	0	0	1	0	16
68.	Aurora	2	2	1	3	7	2	3	3	8	1
69.	Bayo Camana	0	1	0	0	14	1	1	2	0	13
70.	Bonita	0	1	0	0	14	0	3	1	1	12
71.	Bush Romano 14	2	0	2	0	11	1	2	7	5	2
72.	Caballero	0	0	0	1	14	0	3	4	0	10
73.	Cacahuete 72	0	1	1	1	12	0	7	6	3	1
74.	Canario L. M.	1	0	0	0	14	1	1	1	1	14
75.	Compuesto Cotaxtla	0	0	1	1	13	0	2	4	9	1



BIBLIOTECA

Table 4. Continued

IBRN Entry No.	Identification	No. of locations where the entry was classified as:									
		1975					1975				
		Immune	Resistant	Intermediate	Susceptible	No data	Immune	Resistant	Intermediate	Susceptible	No data
76.	Costa Rica 1031	0	3	1	0	11	4	3	6	3	1
77.	Guatemala 416	0	2	2	1	10	2	1	3	10	1
78.	Honduras 46	0	2	2	1	10	1	1	4	10	1
79.	La Vega	3	1	1	0	10	3	4	4	5	1
80.	Manteigao Preto 20	1	1	2	0	11	0	6	6	4	1
81.	Mexico 142-N	1	1	2	0	11	2	0	3	2	10
82.	Mexico 235	2	1	2	0	10	6	4	4	2	1
83.	Miss Kelly	1	1	1	1	11	2	1	6	7	1
84.	Mogul	2	2	3	0	8	1	2	7	6	1
85.	Mountaineer White Half Runner	0	3	2	2	8	0	2	8	6	1
86.	Negro de Chincha	0	0	0	0	15	1	2	3	0	11
87.	Ormiston	2	1	0	1	11	2	0	3	0	12
88.	Panamito Corriente	1	0	1	1	12	3	1	8	4	1
89.	Pinto Serrano	0	0	0	0	15	3	1	2	0	11
90.	P.I. 165435	1	2	2	1	9	3	0	5	8	1
91.	P.I. 207262	0	1	1	1	12	2	1	3	10	1
92.	P.I. 310739	1	1	4	0	9	2	2	4	8	1
93.	P.I. 310814	0	0	3	2	10	1	0	5	10	1
94.	P.I. 310878	1	1	3	1	9	2	2	4	8	1
95.	P.I. 313524	2	1	2	0	10	4	2	7	3	1
96.	Plomo	0	0	0	0	15	0	2	0	0	15
97.	Portland Red	0	0	0	4	11	1	0	4	11	1
98.	Portugal	2	1	0	1	11	2	5	5	2	3
99.	Preto 897	1	1	2	1	10	4	1	6	5	1
100.	PR 2	3	0	1	1	10	2	1	1	3	10
101.	PR 6	3	3	2	0	7	3	5	2	6	1
102.	PR 7	0	0	1	1	13	2	0	2	2	11
103.	PR 15	0	1	2	2	10	1	6	4	5	1
104.	PR 18	2	0	1	1	11	0	5	7	4	1
105.	Redlands Autumn Crop	2	1	1	0	11	0	9	5	2	1
106.	Redlands Green Leaf C	1	2	2	0	10	1	7	6	2	1
107.	Cuva 168-N	5	4	1	2	3	5	4	3	4	1
108.	Redlands Green Leaf B	7	3	2	0	3	2	8	5	2	0
109.	Bountiful 181	3	4	3	5	0	0	6	6	5	0
110.	Brown Beauty	1	1	1	3	9	0	2	9	5	1
111.	Canario 101	5	2	2	3	3	0	9	4	4	0
112.	California Small White 643	3	5	2	1	4	2	6	5	3	1
113.	C. C. G. B. 44	2	1	1	1	10	3	1	5	7	1
114.	Dade	0	3	0	0	12	0	1	0	3	13
115.	Epicure	0	0	1	2	12	1	0	2	13	1

Table 4. Continued

IBRN Entry No.	Identification	No. of locations where the entry was classified as:									
		1975					1976				
		Immune	Resistant	Intermediate	Susceptible	No data	Immune	Resistant	Intermediate	Susceptible	No data
116.	Golden Gate Wax	2	3	7	2	1	2	1	6	7	1
117.	Kentucky Wonder 765	4	7	1	2	1	1	5	7	3	1
118.	Kentucky Wonder 780	0	4	4	6	1	1	2	8	6	0
119.	Kentucky Wonder 814	2	6	4	2	1	2	2	6	7	0
120.	Mulatinho	1	0	2	1	11	2	3	1	9	2
121.	Pinto No. 650	0	1	3	12	0	0	0	0	16	1
122.	U. S. No. 3	1	1	3	8	2	1	0	2	13	1
123.	Veracruz 1A6	0	3	2	0	10	1	0	9	6	1
124.	Aguascalientes 13	0	0	0	0	15	0	0	2	4	11
125.	Guerrero 6	0	0	0	0	15	1	1	4	0	11
126.	Guerrero 9	0	0	0	0	15	0	0	2	4	11
127.	Guanajuato 10-A-5	0	0	0	0	15	0	1	2	3	11
128.	Jalisco 33	0	0	0	0	15	0	1	1	1	14
129.	Mexico 6	0	0	0	0	15	1	2	2	1	11
130.	Mexico 12	0	0	0	0	15	0	1	2	3	11
131.	Negro 150	0	0	0	0	15	1	1	1	1	13
132.	Veracruz 10	0	0	0	0	15	0	1	3	2	11

Table 5. Reactions of the most widely resistant entries in 1975 and 1976 IBRN's.

IBRN Entry No.	Identification	Number of locations where the entry was classified as:									
		1975					1976				
		Immune	Resistant	Intermediate	Susceptible	No data	Immune	Resistant	Intermediate	Susceptible	No data
7	Compuesto Chimaltenango 3	4	3	2	1	5	5	9	2	1	0
14	Turrialba 1	4	3	2	3	3	3	7	6	1	0
52	ICA-Pijao	3	1	4	3	4	3	6	7	1	0
2	Redlands Pioneer*	0	0	0	0	15	2	7	5	2	1
8	SB-30-CI-PM-PI	0	1	0	1	13	3	6	5	2	1
13	Mexico 309	6	5	1	0	3	6	3	3	2	0
18	San Pedro Pinula	4	3	3	2	3	4	6	5	2	0
26	Ecuador 299	5	7	1	0	2	3	6	6	2	0
44	Cornell 49-242	3	5	4	1	2	2	4	9	2	0
63	P.I. 226895	4	6	2	0	3	1	5	7	2	2
82	Mexico 235	2	1	2	0	10	6	4	4	2	1

* Redlands Autumn Crop, Redlands Green Leaf B and Redlands Green Leaf C had reactions similar to Redlands Pioneer.



Table 6. Summary of rust classifications by location in 1975 and 1976 IBRN's.

Location*	No. of entries classified as:				
	Immune	Resistant	Intermediate	Susceptible	No data
<u>1975</u>					
BRAV	9	14	31	9	69
CI74	0	20	15	20	77
CI02	13	32	44	4	39
CI04	32	19	26	16	39
CI10	5	21	37	44**	25
CORI	19	8	32	3	70
ECUA	2	34	10	8	78
GUAT	37	22	3	0	70
PE74	1	4	0	10	117
PERU	41	2	1	12	76
PURI	8	14	21	19	70
PURL	12	5	18	24	73
USAB	16	49	21	20	26
USAF	34	5	13	0	80
USAM	36	16	5	0	75
<u>1976</u>					
AUST	63	0	48	10	11
BRAG	1	19	9	32	71
BRAV	10	22	61	10	29
BR77	2	23	49	44	14
CIAT	18	25	21	62	6
CORI	2	20	24	59	27
DORE	14	6	18	67	27
ECUA	0	10	44	51	27
ELSA	2	19	62	22	27
EL77	0	66	40	12	14
GUAT	0	34	31	41	26
MEXC	9	1	18	87	17
PERU	81	5	1	18	27
PURI	6	33	33	33	27
PURL	4	12	36	51	29
USAB	13	48	44	27	0
USAM	46	63	18	3	2

* See computer codes for locations in Table 1.

** Locations with the highest proportion of susceptible entries in 1975 or 1976