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REACTION OF SOME CASSAVA ACCESSIONS TO RED SPIDER MITE (*Tetranychus kanzawai* Kishida) INFESTATION

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ABSTRACT

A satisfactory technique for evaluating cassava accessions/varieties for resistance to the red spider mites in the field or screenhouse was developed. Of the 295 entries tested, 50 showed varying levels of tolerance to the pest when tested in the field. At a much higher mite population in the screenhouse, however, practically all the accessions showed lower levels of tolerance although leaves of the more tolerant accessions 17, 29, 33, 48 and 49 were still green when the susceptible checks began to get defoliated. Differences in tolerance levels were most evident 3 weeks after artificially infesting each plant with 20 reproducing adult mites. Significant antibiotic effects of the resistant hosts on the pest were not detected.

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KEY WORDS: Red spider mite. *Tetranychus kanzawai*. Evaluation technique. Cassava accessions. Tolerance.

INTRODUCTION

The cassava red spider mite, *Tetranychus kanzawai* Kishida, is a serious acarine pest of cassava throughout the Philippines (PCARR, 1977; Sieng, 1973, Pama, 1961). The mite damages the cassava plant by feeding on the undersurface of mature leaves causing them to turn yellow and fall off. When infestation becomes heavy, the mites move to younger leaves and may cause complete defoliation of the plants thereby affecting the yield especially when this happens at the tuber formation stage. The mites form "ballooning threads" to facilitate movement from one plant to another.

Over the past few years, experimental cassava plantings in ViSCA have been attacked heavily by this pest at certain times usually from February to June each year (Bernardo and Esguerra, 1981) and satisfactory control can only be achieved by using wide spectrum but expensive miticides.

The most widely practiced control measure is spraying the infested cassava plants with either Benlate or Azodrin several times during the growing season. However, despite their being effective against the mites, farmers find it increasingly difficult to rely solely on these pesticides because they have become too expensive, coupled with the development of resistance to chemicals as a consequence of continuing pesticide use.

The use of cheaper and safer methods of controlling cassava spider mites, such as planting resistant varieties, will be very advantageous to farmers. Unlike in other countries, however, very little work has been done in the Philippines to develop spider mite-resistant varieties which also possess desirable agronomic qualities like good eating quality and high yield. In Cali, Colombia, varieties with some resistance to *Tetranychus urticae* and *Mononychellus tanajoa* (CIAT Annual Report, 1976) were identified but only 0.4% of the germplasm collections were resistant to the former mite species and about 14% to the latter. In Kerala, Saradamma and Das (1974) found varieties Ekavan, H97, H226, Kalikalan, Kayyalachady and H165 to be resistant to *T. urticae* as shown by longer developmental period, shorter longevity and lower fecundity of mites reared on said varieties.

This study was conducted to: (a) develop a technique for rapid screening of cassava accessions/varieties for resistance to the red spider mite; (b) evaluate the reaction of all available introduced and local cassava accessions to the pest; and (c) determine the mechanisms of resistance of the promising accessions.

MATERIALS AND METHODS

Screening for Resistance

1. *Field Test.* — Mature stalks of 295 introduced and local cassava accessions were planted in single rows in batches of 30-40 accessions. The same check, Golden Yellow variety, was included in each batch. Ten 25 cm long cuttings of each accession were planted to each row at a distance of 75 cm between hills and 100 cm between rows. Golden Yellow variety was planted every other two rows and on borders to serve as the check. To maintain good growth of the plants, recommended cultural practices on cultivation, weeding, fertilization, among others, were followed.

At 2 1/2 - 3 months from planting, all cassava accesions were artificially infested with spider mite-infested leaves collected from other cassava fields, making sure that they were free from predators. The infested leaves were distributed among the plants as evenly as possible to make sure that all of the accessions got infested with mites.

Sampling for mite population from each accession was started as soon as the standard check showed symptom of mite damage. Five randomly selected mature leaves were taken from each accession, placed on properly labelled plastic bags, and brought to the laboratory. Counts of mites in different stages of development were taken using a stereoscopic microscope. Mite damage on each accession was also determined by observing 5 randomly selected plants at weekly intervals starting at 2 weeks after introducing mite-infested leaves up to harvest time using the following scale:

1 - Plants without mites; no damage.
2 - Basal or mid-leaves with some light yellow specklings; about 10-20 specks grouped or dispersed over each leaf.
3 - Basal or mid-leaves with definite or noticeable yellow specklings, about 50-100 spots per leaf.
4 - Extensive damage on basal and middle leaves of plants; leaves completely speckled; yellowing and necrosis of basal leaves; webbing on some leaves.
5 - Plants with general yellow appearance; mites on all leaves; basal and middle leaves mostly affected; webbing on some leaves.
6 - Plants severely defoliated; mites abundant on all parts of the plants; leaf necrosis, plants may die.

At the end of each growing period, the data were summarized and each accession was categorized as either resistant (R), with 1 to 2 damage rating, moderately resistant (MR) with 2.5 to 3.5 damage rating or susceptible (S) with 4 to 6 damage rating based on the degree of mite damage on the leaves and on red spider mite population.

2. *Greenhouse Test.* — All the cassava accessions tested in the field were also evaluated for resistance under a more intense pressure of the cassava red spider mite. Ten 25 cm cuttings of each accession were planted in two rows in seedboxes filled with sterile soil. Cuttings of Golden Yellow variety were planted as border plants. To assure healthy growth of seedlings, watering and fertilizer application were done when necessary.

About one month after planting, the seedlings were artificially infested with red spider mites taken from the field. The infested leaves were placed between the rows of test accessions. This was supplemented later by 3 reproducing adults placed directly on each plant. To prevent the naturally existing predators such as cecidomyiids, coccinellids, thrips and staphylinids from significantly reducing the spider mite population, Sevin at half the recommended rate stated on the label was sprayed on the accessions twice, the first spray immediately before introducing the mites and the last spray one week after introducing them. When injury on the leaves were already apparent, the reactions of the different accessions were evaluated based on the degree of mite damage on the leaves and on mite population counts using the procedure described in the field test.

Determination of the Mechanism of Resistance

Fifty cassava accessions which showed either high or moderate levels of resistance to the cassava red spider mite from field or greenhouse tests were selected and subjected to a more refined test to determine their mechanism of resistance to the red spider mite. These accessions were again planted in seedboxes in the screenhouse (Fig. 1). Proper care of plants was maintained to ensure good growth. One month after planting, 6 reproducing adult spider mites (5♀ - 1♂) were released on 3 randomly selected leaves per accession, allowed to lay eggs and were later killed. The extra eggs were removed leaving only 20 which were allowed to hatch and develop.

Survival of the nymphs and the adults that developed subsequently were observed weekly from each accession using a magnifying glass. Population build-up of the spider mite was determined by randomly sampling 3 leaves of each accession at weekly intervals and counting the mite in different stages. Mite damage was assessed by observing 3 randomly selected plants from each accession using the damage rating scale mentioned under field test. The general appearance of each accession as well as the texture and color of the leaves were also observed.

Some of the most promising accessions identified in the field test were subjected to another trial, this time introducing 20 reproducing adult mites as initial population on each plant one month after planting.

As soon as mite injury began to show on the leaves, weekly leaf

Fig. 1. Some cassava accessions before the introduction of 20 reproducing adult mites.

sampling was done to measure mite population build-up in the test accessions. Assessment of mite damage was likewise taken from 3 randomly selected plants in each accession using the same damage rating scale for the field and screenhouse tests. Resistance was measured based on mite population build-up and damage rating.

RESULTS AND DISCUSSION

Field and Greenhouse Screening Tests.

The technique used for varietal evaluation in the field and in the screenhouse was found satisfactory. Fifty promising cassava accessions (Table 1) were selected out of the 295 accessions tested in field trials for resistance to the cassava spider mite from 1977 to 1980. Most of the accessions were susceptible to the mites and were defoliated (Fig. 2). The average damage ratings of the promising accessions ranged from 2.5 to 3.5. However, when these accessions were subjected to screenhouse tests, those rated resistant in the field showed only moderate levels of resistance, while the moderately resistant, except accessions 33 and 82, completely succumbed to mite damage. This was due to the higher mite population build-up in the screenhouse (about 3 times higher than field population) favored by optimal condition for mite development and freedom from active predation by natural enemies such as coccinellid

Table 1. Cassava accessions that showed resistance to the cassava red spider mite in the field and screenhouse tests from 1977-1980[1].

Accession Number	Reaction to the red spider mite	
	Field	Screenhouse[2]
1	MR	S
2	MR	S
3	R	MR
4	R	MR
5	MR	S
10	MR	S
17	R	MR
19	R	MR
20	R	MR
23	R	MR
28	MR	S
29	R	MR
32	R	MR
33	MR	MR
34	MR	S
38	MR	S
39	R	MR
41	MR	S
43	MR	S
47	MR	S
48	R	MR
49	R	MR
50	MR	S
54	R	MR
55	R	MR
59	MR	S
60	MR	S
64	MR	S
66	MR	S
71	MR	S
72	MR	S
73	MR	S
74	MR	S
81	R	MR
82	MR	MR
83	MR	S
108	MR	S
112	MR	S
117	MR	S
120	MR	S
164	MR	S
184	MR	S
217	R	MR
218	R	MR
220	R	MR
221	R	MR
222	MR	S
232	MR	S
237	MR	S
243	R	S
GY	S	S

[1]Based on combined mite damage rating and population counts.

[2]Reproducing adult spider mites (5♀ and 1♂) were released on each plant.

R - Resistant

MR - Moderately resistant

S - Susceptible

beetles, cecidomyiid and thrips that usually increase in number in the field as soon as spider mites start to reproduce.

Despite supporting high population of spider mites, the 20

Fig. 2. Cassava plants heavily infested with red spider mites showing some defoliated stems.

moderately resistant accessions were still growing and their leaves remained fairly green (Fig. 3). Some of these accessions were therefore selected and used for the study on their mechanisms of resistance to the spider mite.

Based on the results of the field and screenhouse tests, varietal screening may be done in the field to identify the most resistant accessions to spider mites from the bulk, provided that a sufficient level of mite population exists. Because of the sensitivity of the pest to adverse weather conditions, particularly heavy rains, it would be most practical to conduct screening tests during the dry season. At this time the most important problem to contend with is the greater prevalence of predators due to increased mite population. These predators tend to stay on the same plant provided that adequate prey is still available. Thus, a plant may appear to be more tolerant than the others because of the reduced mite population it supports. This masking effect of predator action can be minimized by periodic application of Sevin insecticide which does not adversely affect the mites.

If facilities would allow, initial varietal evaluation in the screenhouse is recommended for convenience provided that artificial infestation is applied. It should be kept in mind, however, that there is a tendency to underestimate the level of resistance of the test varieties because of the inevitable higher mite population build-up in the screenhouse. Furthermore, due to space limitation among other factors, screenhouse-raised seedlings may not fully manifest their potential to withstand mite damage compared to those planted in the field. Thus, reaction of a variety to pest damage in a screenhouse may not be an exact replica of its reaction in the field. Painter (1951) reported the failure of wheat variety Rescue to manifest in the greenhouse its resistance to stem sawfly shown in the field. This was attributed to the sensitivity of the variety to changes in environmental conditions particularly to light intensity.

Defoliation of cassava stems or severe damage on the foliage may result in significant reduction in yield if this happens during the initiation of tuber formation up to the active stage of tuber enlargement (Personal communication, Bellotti, 1977). This usually occurs during the second to the fifth month from planting as reported by Wholey and Cock (1974). Since it is hardly possible to have normally growing cassava plants of this age in the screenhouse, it is then necessary to test the promising varieties identified in screenhouse tests under field conditions.

Mechanism of Resistance of the Promising Accessions.

Practically all the resistant accessions were able to withstand the population that developed from the 6 adult mites (1♂ and 5♀) introduced per plant, although it was already

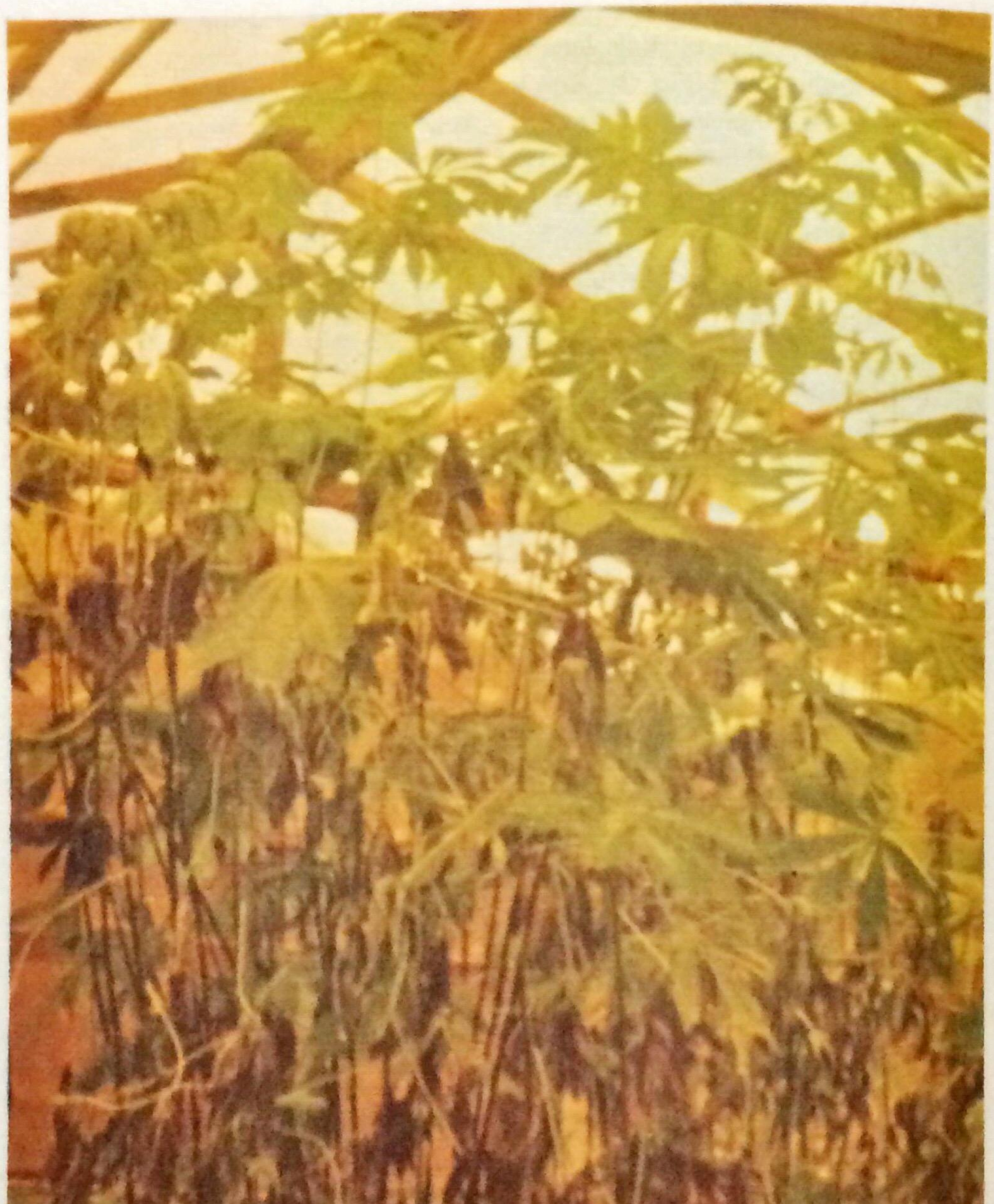

Fig. 3. Some cassava accessions showing varying degrees of susceptibility to mites 3 weeks after introducing 20 reproducing adults.

about 3 times as much as the naturally occurring population in the field. With this mite population to support, marked variations in the levels of resistance were observed only between the susceptible checks and the resistant entries. Narrower variations among the promising varieties were not visible enough to suggest more conclusively the mechanism of resistance involved. Therefore, results of this test were considered preliminary but nonetheless useful because the approximate level of initial mite population needed was perceived.

Table 2 shows the reaction of some accessions representing varying levels of resistance when 20 reproducing adult mites were introduced per plant. At 2 weeks after introduction of the mites, only slight variations in damage ratings were evident. A week later, however, the two susceptible entries (Accession 7 and GY) already became defoliated while the more resistant entries (Accessions 17, 29, 33, 48 and 49) showed only moderate degrees of damage. At 4 weeks after infestation, even the tolerant varieties exhibited high degree of damage.

This high damage ratings at the fourth week of the accessions considered "tolerant" may not necessarily mean that said plants are not capable enough to withstand mite damage. The population level to which the test accessions were subjected in the screenhouse would probably occur in the field only during outbreaks. Therefore, these accessions should be able to readily withstand the normal levels of mite population in the field without incurring significant yield reduction.

Table 2. Number of mites per leaf[1] and damage ratings[2] of representative cassava accessions when 20 reproducing adult spider mites were released on each plant.

Accession No.	Reaction in Screening Test[3]		2 weeks after infestation			3 weeks after infestation			4 weeks after infestation		
	Field	Screenhouse	Eggs	Nymphs & Adults	Damage Rating[4]	Eggs	Nymphs & Adults	Damage Rating[4]	Eggs	Nymphs & Adults	Damage Rating[4]
1	MR	S	316	212	2	2865	814	5	—	—	Defoliated
3	R	MR	456	214	2	2914	812	4	2004	1699	5
17	R	MR	265	496	2	1374	894	3	1649	1464	5
29	R	MR	430	647	2	3174	551	3	1623	1286	4.3
32	R	MR	560	614	2	2131	1065	4.3			Defoliated
33	MR	MR	215	291	2	1840	939	3	3186	1618	5
34	MR	S	228	457	2.7	3072	1178	4			Defoliated
39	R	MR	365	488	3	2272	1228	5			Defoliated
48	R	MR	373	193	2	2746	1335	3	1622	1123	5
49	R	MR	368	157	2	2022	1027	3.3	1706	1186	5
7	S	S	268	94	2.3			Defoliated			
GY	S	S	416	252	3			Defoliated			

[1]Based on 3 randomly selected leaves per accession.
[2]Based on 3 randomly selected plants per accession.
[3]R = Resistant; MR = Moderately Resistant; S = Susceptible.
[4]Based on a rating scale of 1 for least damaged and 6 for severely damaged or defoliated.

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