

Mechanisms of Resistance to Melon Aphid in a Muskmelon Line¹

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Abstract. When free choice was available in the field, build up of melon aphid (*Aphis gossypii* Glover, Western Biotype) was extremely low on *Cucumis melo* L. breeding line LJ 90234 derived from PI 175111, even if it was next to heavily infested susceptibles. LJ 90234 infested with large no. of aphids which were given no choice for food survived with little injury while treated susceptible hosts were killed. Melon aphid nymphs confined on young mature leaves of LJ 90234 often died and survivors grew slowly to small body size and their fecundity was reduced. LJ 90234 is attacked by other insects, however. LJ 90234 appears to exhibit nonpreference, apparent tolerance, and apparent antibiosis to the melon aphid.

Inbred muskmelon LJ 90234 selected from PI 175111⁵ from India was resistant to melon aphid in a replicated field trial at the University of California South Coast Field Station, Santa Ana in 1968. Most entries, including those resistant to melon aphids in Texas and the Southeast, supported large populations of the aphid and suffered leaf curl (roll) and severe damage (2). In contrast, few aphids occurred on LJ 90234. Its leaves remained flat; the plants, vigorous. It did suffer damage from other insects and viruses in the unsprayed planting.

Nonpreference. In 1970, LJ 90234 and its inbreds and F₁ hybrids with susceptible muskmelons supported few aphids and remained green and vigorous in a replicated trial at Santa Ana. The natural aphid population failed to build up in the planting which contained mostly resistant entries. Aphids cultured from Santa Ana were released in control plots of 'PMR 45' in July. A month later aphids still had caused little

damage to most entries in the test plot, but powdery mildew had caused severe injury to a few very susceptible entries, and all plots suffered damage from other insects and several viruses (Table 1).

Aphids became very abundant in the buffers of 'Topmark' and 'Golden Gate 45' at the ends of the test planting. Old leaves that were fully mature when the aphids attacked did not curl, but many died and turned brown. Green leaves supported populations estimated at 3000 per leaf compared with 1395 per leaf on 'PMR 45' in the test area and often none on LJ 90234 and its derivatives including those adjacent to highly susceptible plants (Table 1). Thus, aphids given free choice avoided LJ 90234 and its hybrids. The plants therefore escaped attack through nonpreference (3).

The fruits of LJ 90234 are commercially unacceptable (Fig. 1). We studied the nature and inheritance of resistance in controlled greenhouse tests to learn if resistance could be utilized in breeding.

Apparent tolerance. LJ 90234 infested with large no. of aphids, which were given no choice for food in tests with individual plant cages and population cages, survived with little to moderate injury compared to dead or nearly dead susceptible muskmelons. Noninfested controls in an adjacent greenhouse remained healthy.

Aphids left the dead and dying nurse plants, and, with no other food source, many attacked the resistant plants. F₁ hybrids were vigorous and flat-leaved beside stunted susceptible parents or nurse plants (Fig. 2). Resistant plants and susceptible plants occurred in backcross populations (Fig. 3). The

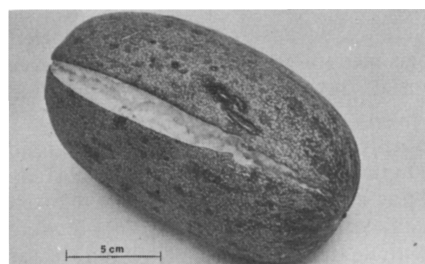


Fig. 1. Typical mature fruit of aphid-resistant muskmelon LJ 90234.

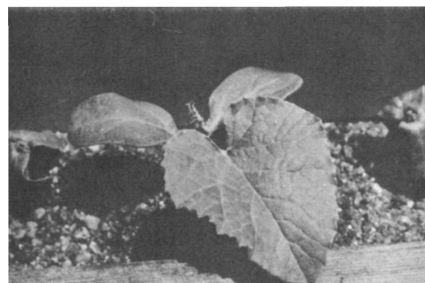


Fig. 2. Melon aphid resistant seedling between 2 susceptible seedlings ('Hale's Best Jumbo') 8 days after infestation by melon aphids.

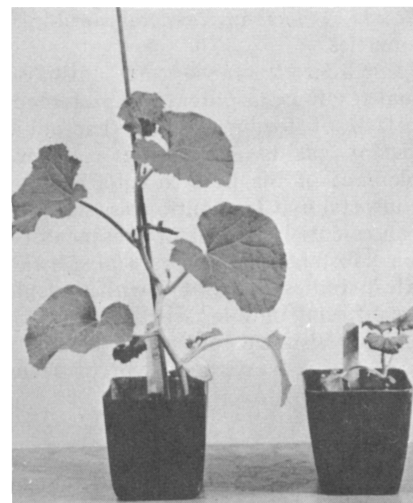


Fig. 3. Heterozygous resistant BC₂ selection from the cross 'PMR 45' x LJ 90234, left, and susceptible 'PMR 45' recurrent parent, right, exposed 8 days to mass infestation by *Aphis gossypii*, treated with nicotine sulfate, and allowed to recover for 7 days. Greenhouse, Riverside, California. 1971.

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⁵PI 175111 was received as *Cucumis sativus* L. but the packet contained a few seeds of *C. melo*. The muskmelon plants from the latter seeds varied greatly in all characters. They were reassigned to PI 371395.

Table 1. Performance of aphid-resistant muskmelons at the University of California South Coast Field Station, Santa Ana, during summer 1970.

Cultivar or line	Source	Insect rating ²			
		% miner damage	% beetle damage	Relative ^y hopper damage	No. aphids per leaf
PMR 45	Dessert Seed Co.	10	17	5.3 d ^x	1395 a
LJ 90234	PI 175111-1 self	13	33	7.5 bc	5 b
LJ 91059	LJ 90234 self	3	36	7.5 bc	2 b
LJ 91060	LJ 90234 self	8	37	8.5 b	7 b
LJ 91064	LJ 90234 self	11	41	9.0 a	1 b
LJ 23740	PMR 45 x LJ 90234	14	26	5.8 d	11 b

²Miner and beetle damage scored June 5, hopper damage scored July 26 and Sept. 1, aphids counted Sept. 27.

^yHopper damage rating: 1, none to 9, heavy.

^xMeans in columns followed by a common letter do not differ at the 5% level by Duncan's Multiple Range test.

resistance illustrated appears to be tolerance because the plants supported large no. of aphids that would have caused severe injury to susceptible plants (1, 3).

Apparent antibiosis. Melon aphid nymphs confined in cages (Fig. 4) on young-mature leaves of LJ 90234 often died. Survivors grew slowly and were stunted (Fig. 5), and their fecundity was reduced. On resistant plants where 20 nymphs were placed (5 aphids on each of 4 leaves) averages of 10 to 33 were alive after 6 or 7 days compared to averages of 171 to 375 on controls (Table 2). The host therefore exhibited antibiosis to the aphid (3).

The antibiosis factor was effective against 2 other collections of the Western Biotype of *Aphis gossypii* from Southern California (Table 3).

The antibiosis factor apparently had no effect against several other insects; especially western flower thrips, *Thrips frankliniella* Thunb. (2) and western potato leaf hopper, *Empoasca abrupta* Del. (Table 1). These 2 insects thrived on LJ 90234; so there is little reason to believe that an aphid-antibiotic factor in LJ 90234 has any general antibiotic properties.

Apparent tolerance and antibiosis could result from potent nonpreference by lack of feeding. Proof that aphid resistant plants have true tolerance (tolerance of the host to equal feeding by insects) and true antibiosis (Absence of an essential element or presence of a toxic substance in the host) must await critical studies, preferably with isogenic lines differing only in resistance.

The resistance of muskmelon LJ 90234 to the Western Biotype of *Aphis*



Fig. 4. Melon aphid antibiosis test replicated on 4 leaves of each plant with 5 nymphs placed in each cage.

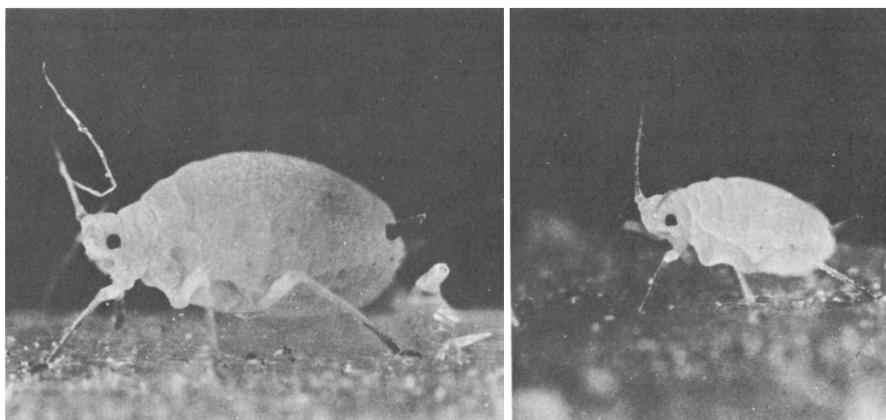


Fig. 5. Adult wingless aphids grown on susceptible, left, and resistant, right, plants of *Cucumis melo* L. Greenhouse, Riverside, California, 1971. Some winged adults are produced on both susceptible and resistant hosts.

Table 2. Reproduction^z of melon aphids^y on seedlings of *Cucumis melo* in the greenhouse, Riverside, California, 1970.

Cultivar or line	Average no. aphids per plant ^x				
	1	2	Test 3	4	5
PMR 45	375	204	261	176	171
LJ 90234	33**	28**	25**	17**	10**

^zInfested with 20 aphids, 5 on each of 4 leaves, and counted 6 or 7 days later.

^y"Riverside" culture collected by R. C. Dickson on watermelon in Imperial Valley, 1963, maintained on watermelon until spring 1969, subsequently on 'Jacumba' muskmelon (2).

^xNo. of plants varied from 6 to 11.

**Significantly lower than PMR 45 at the 1% level.

Table 3. Reproduction^z of 3 melon aphid collections on seedlings of *Cucumis melo* in the greenhouse, Riverside, California, 1970.

Cultivar or line	Average no. aphids per plant ^y		
	Aphid collection		
	Riverside ^x	Brawley ^w	South Coast ^v
PMR 45	106	65	104
LJ 90234	36**	7**	36**

^zEach plant infested with three 24- to 48-hr old nymphs on Feb. 12, 1970; counted on Feb. 19.

^yNo. of plants for each average varied from 18 to 28.

^x"Riverside" culture collected by R. C. Dickson on watermelon in Imperial Valley, 1963 maintained on watermelon until spring 1969, subsequently on 'Jacumba' muskmelon (2).

^wCollected on watermelon at Brawley, Imperial County, California, 1969; subsequently maintained on 'Jacumba'.

**Significantly lower than PMR 45 at the 1% level.

gossypii appears to include nonpreference, tolerance, and antibiosis. In backcrosses to susceptible types, we have been able to select for tolerance in mass infestation greenhouse trials, and for antibiosis to caged insects among survivors at Riverside. Field resistance is also tested. By crossing plants at La Jolla and using greenhouse tests, after 1 year we have completed the 3rd backcross and maintained resistance.

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