selected on the basis of low seed germination, each had red pigment in the old leaves. Nine selections had solid red leaves, 7 had variegated red leaves and 2 had both red and variegated leaves.

In 1971 leaves of cultivars and selections were evaluated at Gainesville, Florida and Byron, Georgia. Ratings were made in the fall after a series of cool nights and clear days when conditions appeared to be most suitable for pigment development. With both characters, leaves first developed red pigments in the petiole and basal veins and then the reddening progresses toward the distal end. Pigments are visible on the upper leaf surface, but only in the veins of the lower surface. This differs from a red-leaf character described by Blake (2) and leaf variegations in peaches reported by Fogle and Dermen (4) which are readily expressed on young leaves and are visible on both surfaces of the leaf. Variegated red differs from the solid red by consisting of sharply defined patches of red pigment randomly scattered on the leaf (Fig. 1). Trees with solid red generally lose their leaves before trees with red variegated and the latter before trees with normal green leaves. The solid red character eventually covers the entire upper leaf surface. Chromatographic separation indicates that the red anthocyanins involved in these 2 characters were the same.

At Gainesville, of 53 numbered selections with red or variegated leaves, all ripened their fruit in less than 90 days from bloom. There were no known early ripening peach selections in the selection trial that did not show either the solid red or variegated red character. The selections with solid red outnumbered those with red variegated 37 to 13. Three out of the 53 selections had both characters.

At Byron, solid red and variegated red leaves had been noted in seedlings resulting from crosses in which very early maturing pollen parents were used. Fifty-three of 55 numbered selections ripening more than 30 days before 'Elberta' exhibited 1 or both of these color characters. Named cultivars and

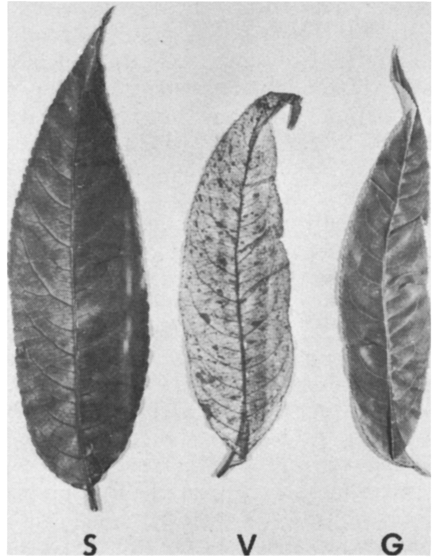

Fig. 1. Solid red (S), variegate red (V) characters, and normal green (G) in mature peach leaves.

numbered selections ripening after 30 days before 'Elberta' had normal green leaves. In fact, 15 of 19 cultivars ripening 30 or more days before 'Elberta' had red leaves (Table 1). There was a tendency for these color characters to be more intense in the very earliest maturing clones and those were also the first to defoliate in the fall.

The average time of fruit development was shorter in the selections with solid red than of those with variegated leaves. Occasionally, both characters appeared together in an individual. The solid red and variegated red characters were expressed on 1-year-old nursery seedlings. Both solid red and variegated red foliage appear to be heritable and gene controlled because solid red or variegated red leafed seedlings respectively, were found in progeny of solid red or variegated red-leafed clones.

Studies are in progress to determine the inheritance of these 2 characters. Our present hypothesis is that these 2 red leaf characters are either controlled by the same or closely linked gene(s) for earliness.

Table 1. Red solid and variegated and normal green ratings in some peach cultivars at Byron, Georgia.

Cultivar	Approx days before Elberta	Red		Normal green
		Solid	Varie-gated	
Springtime	61	x		
Mayflower	58	x	x	
Earlired	55	x		
Springold	53	x		
Collins	50			x
Cardinal	46	x		
Cherokee[z]	46			x
June Gold	45	x		
Hiland	44		x	
Redcap	42			x
Maygold	42		x	
Dixired	42		x	
Springcrest	39	x	x	
Sunhaven	38	x		
Candor	36	x		
Coronet	33	x		
Dixigem	32		x	
Redhaven	30	x		
Troy	30			x
Biscoe	29			x
Ranger	26			x
Nector	24			x
Suwanee	24			x
Velvet	21			x
Washington	21			x
Glohaven	18			x
E. Hiley	17			x
Sunhigh	13			x
Sullivans Early	10			x
Madison	2			x
Dixieland	0			x
Redskin	0			x
Jerseyqueen	0			x

[z]Nectarine

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Resistance to Root-knot Nematode in Bitter Almond Progenies and Almond x Okinawa Peach Hybrids[1]

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Abstract. **Resistance to the root-knot nematode (*Meloidogyne javanica* Chitwood) was established for 7 bitter almond (*Prunus amygdalus* Batsch. var. *amara* DC) F_1 progenies selected from trees in a heavily infested nursery soil and subjected to repeated inoculations in containers. Resistance was very high; (complete in some open-pollinated progenies) suggesting dominance or the presence of a cytoplasmic factor. F_1 hybrid progenies of 2 highly susceptible almond cultivars crossed with 'Okinawa' peach showed almost complete dominance of resistance to *M. javanica*.**

Root-knot nematodes (*Meloidogyne* spp.) are a major hazard to almond culture in warm climates, especially on light or medium-type irrigated soils (6, 10). Both bitter and sweet almond seedling rootstocks are considered highly susceptible. No known source of resistance in the almond has been reported (6, 9).

Seedlings of certain peach rootstocks (3), such as 'Nemaguard' (8) and 'Okinawa' (7) and, recently certain peach x almond hybrids (4) have been found to be resistant to 2 species of *Meloidogyne* (*M. incognita* Chitwood and *M. javanica*). Of these, 'Nemaguard' has often been employed as a rootstock in situations where there is great danger of nematode infestation (5, 6).

Almond seedlings continue to be of importance, especially for calcareous soils. They are also considered more drought resistant than the peach and to give more perfect unions with almond cultivars (1).

The production of nematode-resistant peach x almond rootstocks is more difficult in areas with a warm winter climate, because of the very late-blooming habit of 'Nemaguard' under such conditions. For good seed production either a corresponding very late-blooming and fruitful almond has to be found, or else one has to rely on long-term (10 to 11 months) storage of 'Nemaguard' pollen followed by hand pollination.

The object of this study was a) to determine whether any source of nematode resistance was available in the almond and b) to produce resistant peach × almond hybrids, based on early blooming, low chilling cultivars.

Sources of resistance to nematodes in the bitter almond. Repeated selection was carried out in a population of almond seedlings, grown in nursery plots very heavily infested by root-knot nematodes of both species.

Two hundred surviving almond seedlings were transferred to a light sandy soil heavily infested with nematodes. After 3 years of growth *in situ,* selection was carried out on the basis of plant vigor and examination of root samples for galls and nematode infestation. Of the original 200 trees, 90 were found free of galls and used for further selection.

The almond is self-incompatible and highly heterozygous (1, 9). The progeny of these almonds was therefore expected to be highly heterozygous regarding resistance to nematodes. Open-pollinated seedling progenies were tested for resistance first, with 80% resistance in the progeny considered the minimum threshold for further selection. Controlled pollination between mother trees, or eventual clonal propagation – very difficult to achieve in the almond (4) – were considered if no sufficient resistance was to be found in open-pollinated progeny.

The trees from which seed progeny tests were carried out grew in a plot about 500 m distant from other (mainly later blooming) almond trees. While pollination can thus be fairly safely assume to have taken place within trees of the selection plot, changes in weather conditions from season to season undoubtedly had some effect on the amount and relative period of bloom of the different mother trees in the plot itself.

Resistance was tested in the progenies of each of the mother trees for 3 consecutive years. In each year, those mother trees whose progeny failed to reach the 80% resistance level, were eliminated from the program.

Seedlings were placed in asbestos tanks (120 × 60 × 50 cm) filled with quartz sand and regularly supplied with a nutrient solution; 80 seedlings per tank. Each progeny was divided, randomly, over 4 tanks. Tanks were inoculated at 3 monthly intervals during the growing season with *M. javanica* recovered from tomato roots. Roots were macerated and divided uniformly between seedling rows at a 10-cm depth. Seedlings of the highly susceptible 'Hazanov' ('Poria - 10') sweet almond were grown in each tank to serve as an indicator of the efficiency of the inoculating technique.

All seedlings were lifted at the end of an 8-month growing period and indexed for nematodes according to a scale of 0 (no infestation) to 5 (highest infestation). Only the 7 most outstanding progenies are included in the table, along with the susceptible sweet almond 'Hazanov' progeny (Table 1).

After 3 years of final screening, 7 progenies were found to have high nematode resistance. Of these, 5 progenies were found to be entirely free of nematodes. Nearly all of the progenies also had higher vigor than 'Hazanov' seedlings; this may have been due to the high degree of nematode infestation in the sweet almond progeny.

This is the first time that consistently high resistance to nematodes has been found in almond progeny raised from seed.

The repeatedly high resistance found in the open pollinated progenies listed, leads to the assumption that this resistance was caused by a dominant factor (2) or, alternatively, under cytoplasmic inheritance.

It is possible that a certain difference in mode of inheritance will be found between the first 5 and the last 2 (BA42, BA79) progenies (Table 1).

As no information on the nature of inheritance to nematode resistance in the bitter almond is yet available, controlled reciprocal crosses were carried out in spring 1972 between our resistant bitter almond selections and susceptible sweet almond cultivars.

Sweet almond × 'Okinawa' peach progenies. The nematode-resistant 'Okinawa' peach (7) was chosen as the pollen parent. Its blooming period coincides with that of most of sweet almond cultivars grown in Israel. Hand pollination was carried out between 'Okinawa' and 2 susceptible almond cultivars, 'Hazanov' ('Poria-10') and 'Yevani' ('Greek'), both early blooming and good producers. Hybrid progeny was subjected to the same screening procedure as described before, for 1 season. Seedlings of 2 susceptible local almond × peach hybrids (24-05 and 23-68) and seedlings of the resistant 'Nemaguard' peach were included for comparison. (see Table 2).

Both almond × 'Okinawa' progenies gave a high % of seedlings free of nematodes, and some seedlings evincing small galls and no live larvae. Similar results were reported elsewhere for 'Nemaguard' progeny and 'Nemaguard' hybrids (8).

Infested seedlings were found in the 2 almond × 'Okinawa' progenies, 3% and 1% respectively. This might have been caused by chance contamination in the cross.

Experiments on the value of the nematode-resistant almond and almond

Table 1. Resistance to root-knot nematode, *Meloidogyne javanica,* in progeny of open pollinated bitter almond selections, after 3 years of screening.

Mother tree	No. o.p. progeny examined	Distribution (%) Nematode infestation index[z] 0	1	2	3	4	5	Plant ht[y] (cm)	Shoot diam[y] (mm)
BA 1	60	100	0	0	0	0	0	77a	7.1ab
BA 88	90	100	0	0	0	0	0	68b	6.7b
BA 63	45	100	0	0	0	0	0	66b	7.5a
BA 60	50	100	0	0	0	0	0	67bc	6.8b
BA 201	65	100	0	0	0	0	0	62bc	6.4b
BA 42	45	96	4	0	0	0	0	57bc	6.7b
BA 79	31	87	6	7	0	0	0	64b	6.5b
'Hazanov' o.p.	55	0	0	6	20	22	52	57bc	6.0bc

[z]Rating from 0 (none) to 5 (very heavily infested).

[y]After 8 months in tank. Means with different letters are significantly different at the 5% level according to t test.

Table 2. Resistance to root-knot nematodes *Meloidogyne javanica* in almond x peach hybrid progenies compared with 'Nemaguard'.

Mother reww	No. progeny examined	Distribution (%) Nematode infestation index[z] 0	1	2	3	4	5	Plant ht[y] (cm)	Shoot diam[y] (mm)
Yevani x Okinawa	110	91	6	0	1	2	0	53b	7.7b
Hazanov x Okinawa	130	85	14	0	1	0	0	62a	9.4a
Almond x peach 23-68	40	15	10	13	19	33	0	50b	8.1ab
Almond x peach 24-05	45	30	15	25	25	10	0	40c	6.4c
Nemaguard o.p.	35	79	21	0	0	0	0	53b	7.0c

[z]Rating from 0 (none) to 5 (very heavily infested).

[y]After 8 months in tank.

x peach selections developed by us as rootstocks for the almond, are now under way.

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The Effects of Aqueous Sprays of NH4F on 'Early Improved Elberta' Peaches[1,2]

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Abstract **Aqueous sprays of NH_4F applied to 'Early Improved Elberta' peach trees significantly increased the % of abnormal fruits. Tissue firmness was increased on the dorsal side but decreased on the suture side. Suture tissues contained more F than dorsal tissues and both had higher F levels as the F spray concn increased. The climacteric of treated fruits was initiated before the untreated fruits at every sampling date where a climacteric occurred. Both malic and citric acids were decreased in the suture tissues of F treated fruits.**

Gases, sprays, or particulates containing fluorine have been shown to cause a physiological disorder of peach fruits. This disorder has been referred to as "soft suture" due to premature ripening of the fruit along the suture and has been reported in several areas where atmospheric F exists (1, 2, 3, 4).

The objective of this study was to determine effects other than symptom expression of NH_4F sprays on peach fruits. We also wanted to see whether fluoride induced premature ripening could be detected prior to the appearance of the "soft suture" symptom.

Aqueous sprays of NH_4F were applied to 20-year-old 'Early Improved Elberta' peach trees. Single tree plots, replicated 3 times, were treated as follows: 0.005%, sprayed 15 weeks after full bloom and at 4 weekly intervals; 0.05%, sprayed 13 weeks after full bloom and at 6 weekly intervals and 0.1%, sprayed on the 13th and 14th weeks after full bloom. The 0.1% treatment was discontinued due to leaf injury but 1 additional spray was applied 18 weeks after full bloom because no further symptoms appeared. Five fruits were collected at random from each tree prior to each spray application and grouped into 1 sample. Three of these fruits were placed in 2-liter plastic containers fitted with inlet-outlet tubes, sealed, and air was passed through the system at 200 ml/min. Production of CO_2 was monitored daily with a Beckman Model 215A infrared analyzer. Ethylene production was determined in a 5 ml air aliquot with a Varian Model 1200 flame ionization gas chromatograph using a 1.5m x 3.2 mm (5 ft x 1/8 inch) Porapak Q column. The remaining 12 peaches were washed in cleaning solution (5). Wedge-shaped sections of the suture and dorsal sides of unpeeled fruits were removed and then cut in half (longitudinally). One half was analyzed for F content (5) and organic acid determinations were made on the other half of control and 0.1% sprayed fruits (6). At harvest, fruits were scored visually for symptoms and pressure tested, using a Hunter mechanical force gram gauge with a 1.6 mm (1/16 inch) plunger. Pressures were taken on the suture side of the stylar end and midway on the dorsal side of unpeeled fruits.

Effect of NH_4F on symptom expression and fruit pressure. The % of "abnormal" fruits (1) increased as the NH_4F spray concn increased (Table 1). These data agree with that of Benson (1) and symptom expression and timing on the fruits was similar to that described by Benson (1) and Compton et al. (2, 3, 4). Firmness of the suture side was significantly reduced and firmness on the dorsal side was significantly increased as the F spray concn increased. Using the difference between the dorsal and suture pressures of the control as 100%, there was an increase in % difference as the F spray concn increased. These results suggest that softening was hastened on the suture side, but delayed on the dorsal side.

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Table 1. The effect of NH_4F sprays on abnormal fruit and on fruit pressure of the suture and dorsal side of 'Early Improved Elberta' peaches.

Treatment	% abnormal[z]	Avg pressure (g)[y] Suture	Dorsal	Difference dorsal and suture as % control
Control	6.7	254 cd	287bc	100
NH_4F (0.005%)[x]	32.0	232cd	352ab	370
NH_4F (0.05%)[w]	65.3	198de	368a	525
NH_4F (0.1%)[v]	88.0	143e	372a	705

[z]% abnormal symptoms from 75 fruit.

[y]Means not followed by the same letter are significantly different at the 5% level.

[x]Sprayed once weekly 15-19 wk after full bloom.

[w]Sprayed once weekly 13-19 wk after full bloom.

[v]Sprayed once weekly 13, 14 and 18 wk after full bloom.