

THE ROSE MOSAIC HEAT THERAPY PROGRAM AT FLORIDA SOUTHERN COLLEGE

MALCOLM M. MANNERS
The Citrus Institute
Florida Southern College
Lakeland, FL 33802

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Abstract. "Rose mosaic" (RM) is a disease caused by a complex of plant viruses infecting roses, including prunus necrotic ringspot virus, apple mosaic virus, and possibly other viruses. A large proportion of the commercially propagated roses marketed in Florida are infected with RM. While the disease is not contagious except through budding or grafting, there is nothing the gardener or nurseryman can do to rid infected plants of the disease. The Citrus Institute of Florida Southern College has initiated a heat-treatment program to free the common rose rootstock and scion cultivars of the disease. Symptoms of the disease and means of spread are described, and the heat therapy program at Florida Southern College is explained.

The Citrus Institute of Florida Southern College recently initiated a program to rid infected rose plants of rose mosaic (RM) disease. This paper will describe the disease, its effects on rose plants and their culture, and the heat therapy program at Florida Southern College.

Rose mosaic is a disease caused by a virus complex infecting cultivated roses (*Rosa* spp. and hybrids). Cochran (3) reported that by 1970, most of the garden roses in the United States were infected. Since then, heat therapy programs have been initiated at the Oregon State University and the University of California at Davis. Some commercial rose nurseries have made use of those programs and now offer virus-free plants for sale. However, many nurseries have not made any attempt to provide healthy plants, and a large percentage of the roses grown and sold in Florida are infected. Florida nurseries using *Rosa x fortuniana*, Lindl. as a rootstock are at a particular disadvantage, since scion-source plants of new cultivars are received from a single source, usually on 'Dr. Huey' rootstock, from California. If these original plants are infected, then all plants subsequently produced on *R. x fortuniana* rootstock will be infected. In recent years, virtually all new cultivars, including the All America Rose Selections (AARS) winners, have been diagnosed by leaf symptoms and found to be infected with RM when received by the Florida nurserymen (personal communication from several nurserymen). The disease also may be spread to other cultivars through the use of infected rootstock. No source of indexed virus-free *R. x fortuniana* plants has been available until now, although some propagators have been quite conscientious about selecting their rootstock cuttings only from plants which have never shown symptoms of RM.

Since RM is not fatal to the plant and often has no obvious detrimental effect on a rose, nurserymen and rosarians tend to be unconcerned about the problem. When leaf symptoms appear on a plant, the affected branch is pruned off, temporarily ridding the plant of its symptoms. If (as many growers believe) the only effect of RM is an

occasional chlorotic or disfigured leaf, there would be little cause for concern about the disease. However, RM has been shown to cause flower distortion (2,3,4,8), reduced flower production (3,4,6,8,9), reduced flower size (8,9), reduced stem caliper at the graft union (8,9), reduced vigor (2,3,7,8,9), early autumn leaf drop (8), lower bush survival rates (6), increased susceptibility to cold injury (6), and more difficult establishment after transplanting (8). The symptoms are highly variable among rose cultivars and are strongly influenced by weather and growing conditions. Infected plants may appear to be quite healthy for much of the year, and any symptoms which do appear may be attributed to other causes, such as spray burn, nutrient deficiencies, high temperature, or poor horticultural practices. It has been suggested that the "deterioration" which often occurs in rose cultivars several years after their introduction may be a result of virus infection (1).

Etiology

Rose mosaic is a complex of several viruses which cause similar symptoms in rose plants. The most important of these viruses in the United States is prunus necrotic ringspot virus, a common disease of stone fruit trees (5). Of lesser importance in the USA are apple mosaic virus and arabis mosaic virus. There may be additional viruses involved in the RM complex (6). Several other virus diseases of rose are quite distinct from RM and will not be considered in this paper. These include rose wilt, rose leaf curl, rose streak, rose rosette, and rose spring dwarf.

Means of Transmission

RM is believed to be non-contagious in the field, except possibly through rare natural root grafts. There is no evidence that it ever spreads naturally in the garden or nursery, or through pollen, seed, or seedlings (2). Extensive tests also have failed to transfer RM mechanically (e.g., on pruning tools, grafting knives, etc.) (3). The only known means for transmitting the disease is by vegetative propagation. Cuttings rooted from infected plants, or budded plants produced from infected scions or rootstocks, will be infected in virtually every case. The disease is systemic, so the entire plant is infected, whether or not all of the branches show symptoms. A plant which is infected at the time of propagation will remain infected throughout its life, and a healthy plant at the time of propagation should remain healthy for its entire life, unless an infected scion is budded or grafted onto it.

It is probable that the disease was transferred to roses originally from one of the stone fruits, by graftage (4). It then spread from one rose cultivar to another through infected rootstocks. Two nursery practices contributed to the rapid spread of the disease in the United States:

1. Collecting scion wood for next year's crop from this year's budded plants in the production field, rather than from a separate, disease-free, scion-source garden (4).
2. Collecting rootstock cuttings from suckers on budded plants in the production field, rather than from a

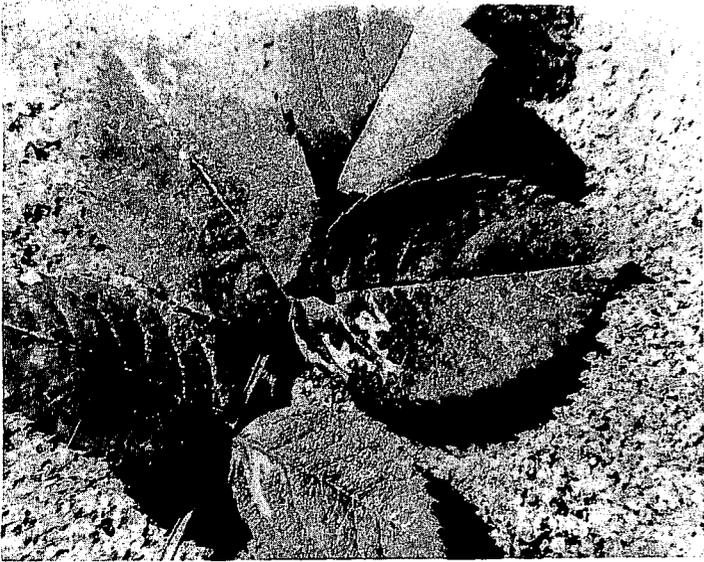


Fig. 1. Typical "mosaic" patterning on a rose leaf. The chlorotic lines may be white or yellow, and vary considerably in shape. The pattern is usually symmetrical around a leaf vein.

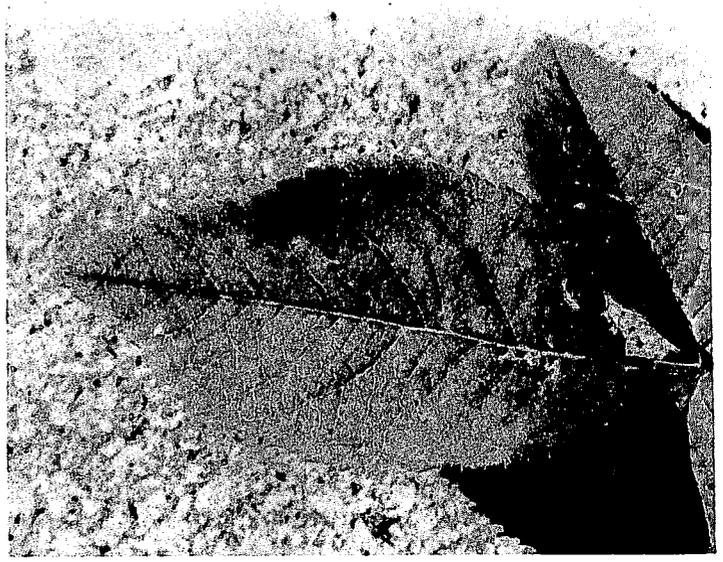


Fig. 3. Yellow fleck symptoms, common in hot weather.

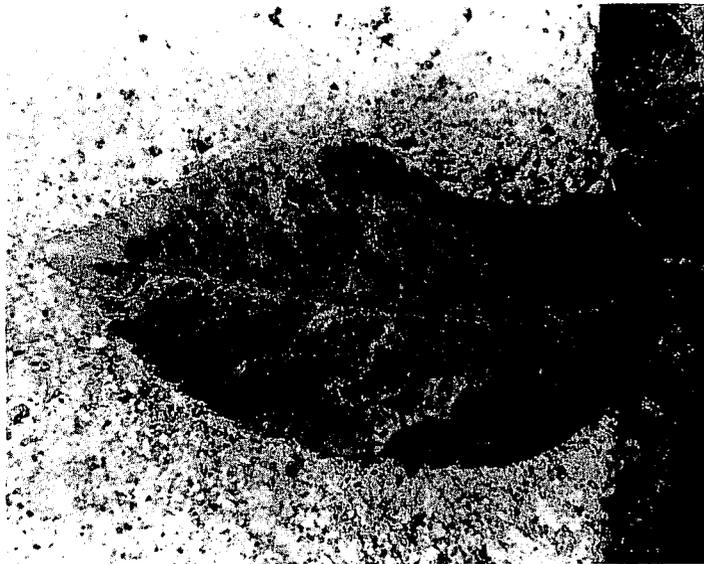


Fig. 2. "Watermark" symptoms of rose mosaic. The swirled pattern is quite irregular, and may be extremely faint.

non-budded, disease-free rootstock planting. In Europe, where rootstock plants are usually produced from seed, RM remains quite rare (3).

Leaf Symptoms

Leaf symptoms of RM are highly variable, often making diagnosis difficult. Some rose cultivars show strong symptoms, while others may be nearly symptomless. Most cultivars will be symptomless for at least part of the year. The most severe symptoms usually are seen during cool weather, in the spring, and are much less severe during the summer months. Some leaves may show "vein-banding", in which the veins are bright orange or yellow, on a green background. Other leaves may show a bright yellow or white "oak leaf" or "mosaic" pattern (Fig. 1). A very faint "watermark" chlorosis is common on the leaves of



Fig. 4. Leaf distortion associated with yellow fleck symptoms.

some cultivars (Fig. 2). These symptoms often fade as the leaf ages, and may disappear completely. During Florida's hot summer months, small yellow flecks, usually associated the veins of the leaf, are more common (Fig. 3). These spots usually do not fade with age and eventually may die, leaving tiny necrotic spots or holes in the leaf. Leaves

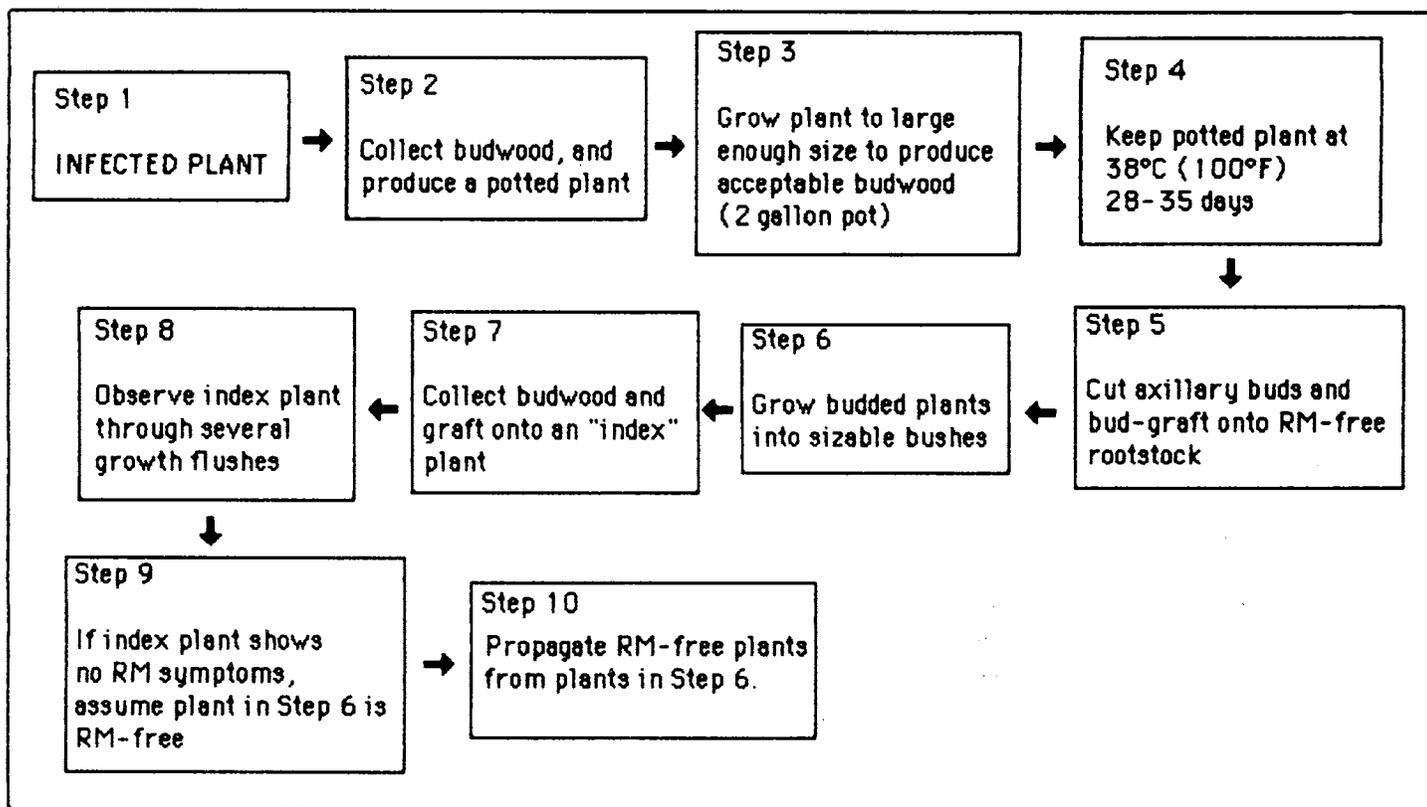


Fig. 5. Summary of the procedure used to rid a rose cultivar of rose mosaic disease.

exhibiting these symptoms often are distorted or dwarfed due to reduced growth in the vicinity of the spots (Fig. 4). The chlorotic patterns associated with RM usually do not closely resemble any mineral nutrient deficiency or herbicide toxicity pattern and are reasonably reliable for diagnosing RM. Some insect or mite damage may mimic the summer fleck symptoms but probably would not be as uniformly associated with leaf veins as are RM-induced flecks. The absence of any obvious symptoms is no guarantee of freedom from RM; some infected cultivars seldom show symptoms but their performance may be impaired.

The Heat Therapy Program at Florida Southern College

Florida Southern College's heat therapy program has been initiated with the following goals:

1. To produce rootstock plants adapted to rose culture in Florida that are known to be free of RM, particularly *R. x fortuniana* and *R. x odorata* (Andr.) Sweet.
2. To rid commonly grown scion cultivars (including old garden rose cultivars) of RM.
3. To provide propagating material of rootstock and scion cultivars to nurseries interested in cooperating with the program, thus enabling Florida residents to purchase disease-free plants on desirable rootstocks.
4. To maintain a RM-free garden for the preservation of healthy germplasm of the treated cultivars.

The heat therapy procedures are similar to those employed by the programs at the Oregon State University and the University of California at Davis. Fig. 5 illustrates the procedure. Infected scionwood is budded or grafted to *R. x odorata* rootstock and grown to a 2-gallon size plant.

The potted plant is placed in a controlled-environment chamber, where the temperature is held at a constant 38°C (100°F) for 28-35 days. The heat treatment does not cure the plant, but RM-free material can be obtained as follows: Axillary buds from the treated plant are budded onto RM-free rootstocks. Most of the axillary buds on the heat-treated plant will be free of RM. Once the new budlings are growing, they must be tested to insure freedom from RM with "index" cultivars, which show very strong symptoms when infected with RM (e.g., 'Ophelia', 'Mme. Butterfly', 'Rapture', 'American Beauty', and 'Reine des Violettes'). For this test, scions are collected from the new budlings and are budded onto the index plant. If the index plant remains free of symptoms after several growth flushes, the original budlings from the heat-treated plant are considered free of RM. Disease-free plants may then be propagated from these budlings either by rooting cuttings or budding onto RM-free rootstocks.

The program at Florida Southern College is less than one year old, and is not yet fully operational. *R. x fortuniana* and *R. x odorata* have been heat-treated and have remained free of RM symptoms but have not been indexed. Several scion cultivars, including the index cultivars, are to be heat-treated in the autumn or winter, 1985. A site has been selected for the germplasm maintenance garden, but has not been planted.

Summary and Conclusions

Rose mosaic disease currently infects a large percentage of the roses grown in Florida, and throughout the United States. While hobbyist growers and most nurseries lack the facilities to rid plants of the disease, cultivars can be freed

of RM by a simple heat treatment program. Florida Southern College is engaged in such a program, and will offer virus-free material to commercial nurseries, to the extent that time and facilities will permit. Since RM is believed never to spread by natural means, there is no legitimate excuse for its continued existence in American rose nurseries and gardens. Improved growth and more flowers of higher quality may be expected from disease-free plants.

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BUTTERFLIES IN THE GARDEN

DALE H. HABECK

Department of Entomology and Nematology
IFAS, University of Florida
Gainesville, FL 32611

Abstract. The numbers of butterflies can be increased by providing suitable nectar plants for the adults and food plants for the caterpillars. Some of the better nectar plants are Spanish needle, lantana, thistle, zinnia, butterfly bush, and butterfly weed. Two useful host plants are passion-flower vines *Passiflora* spp. and *Cassia* spp. Butterfly gardening can help reverse the decline of numbers due to loss of native hosts.

A beautiful butterfly slowly fluttering by is a sight that most of us treasure. Butterflies are often mere transients in our lives appearing only briefly before disappearing into someone else's yard. What can we do to make our contacts with butterflies more frequent and longer?

Bird lovers have had information for years on how to attract and keep birds in their yard. Basically, the advice can be grouped into two categories: 1) providing food and 2) providing suitable habitat for nesting. The same factors have been shown to be effective in attracting and keeping butterflies in butterfly gardens in Great Britain (9,15). In recent years, several articles have appeared containing information on butterfly gardening in the United States (2,10,11,13) and in Florida (5,6,7,14).

There has been no agreement on the number of butterfly species occurring in Florida since some lists include all records and others exclude strays. Emmel (3) reported 144, Emmel and Nation (4) reported 160+ and Kimball (8) recorded about 170 species. Baggett (1) estimated that nearly twenty percent of the butterflies recorded from Florida are infrequent strays and that another 5% may be recently introduced and/or temporary residents.

While butterflies are beneficial as pollinators and generally pleasing aesthetically, the caterpillars of a few species

are economically important. Some of the more important injurious species are the cabbage butterfly *Pieris rapae* L. which feeds on cabbage, broccoli, cauliflower, and other crucifers; the bean leaf roller (also known as the long tailed skipper) *Urbanus proteus* L. which feeds on beans and other legumes; the black swallowtail *Papilio polyxenes* F. feeds on carrots, dill, parsley, and some other Umbelliferae; the greater canna leaf roller (also known as Brazilian skipper) *Calpodex ethlius* Stoll feeds on canna; and the fiery skipper *Hylephila phyleus* Drury feeds on lawn grasses. There are others which are occasional pests such as the giant swallowtail (orange dog) *Papilio cresphontes* Cramer which feeds on citrus foliage.

Butterflies are attracted to flowers with nectar. Since butterflies cannot hover in flight like hawkmoths (Sphingidae) and hummingbirds, there must be room on the flower for the butterfly to perch. The length of the butterfly's proboscis will also determine which flowers are suitable for feeding. A list of preferred nectar sources would vary greatly depending upon the butterfly species, season of the year, and the proximity of other flowers. While some plant species flower throughout the year, others bloom for only a few weeks. Flower characteristics such as color, height from the ground, relative abundance, position and shape on the plant may influence preference (12).

A partial list of butterfly nectar plants is shown in Table 1. The list is incomplete and could be expanded many fold. It is a mixture of wild and cultivated plants some native, some introduced, a few trees and many herbs. Two plants, butterfly bush and butterfly weed, are well known as favorites of butterflies. Butterfly bush is an introduced plant not commonly planted but which deserves more attention from butterfly gardeners. The flowers resemble lilac and can be white, pink, red, purple or shades in between. In Great Britain butterflies prefer the purple varieties (9,15) but in north central Florida, white varieties attract more butterflies (G. Buckingham, personal communication). Butterfly weed in a native milkweed that grows in dry sandy areas. The orange flowers are very attractive to butterflies. Spanish needle is a common widespread weed with seeds that stick to clothing. Most people do not want it in their yard, but it is one of the best butterfly plants. It blooms throughout the year and attracts a wide variety of

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