

Like all vegetatively propagated plants, roses are subject to infection by virus and virus-like diseases that spread during propagating operations. Studies by plant pathologists with the California Department of Food and Agriculture have shown a 14 percent loss in salable blooms of virus-diseased greenhouse roses. Similar losses occur in landscape roses. Diseased plants tend to be less vigorous and less likely to survive than healthy plants, and diseases often detract from the aesthetic quality of the plant.

Rose varieties are generally propagated by budding or grafting desired varieties onto special rootstocks. Rootstocks selected for hardiness, disease and pest resistance, and graft compatibility usually are rooted as stem cuttings directly in the field. Major rootstocks used in California are Manetti, Dr. Huey, *Rosa multiflora* 'Burr,' and *Rosa odorata*.

Any viruses or other infectious agents present in the variety buds or rootstock canes are almost certain to be present in the new plants. Propagation is the most important way by which virus and virus-like diseases are perpetuated and spread in roses. There is evidence that at least two of the diseases—rose leaf curl and rose rosette—may also be spread by an aerial vector, such as an insect or mite.

Virus disease symptoms often are

(Text continued on page 6)

Rose virus and

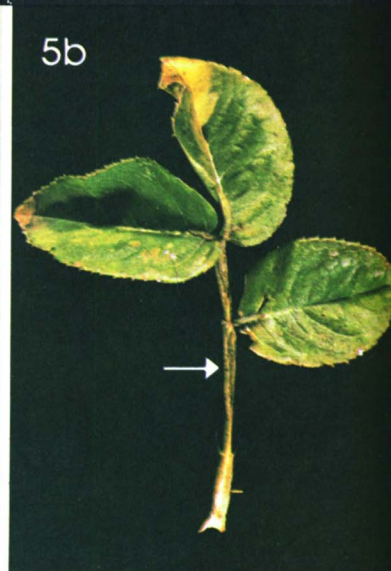
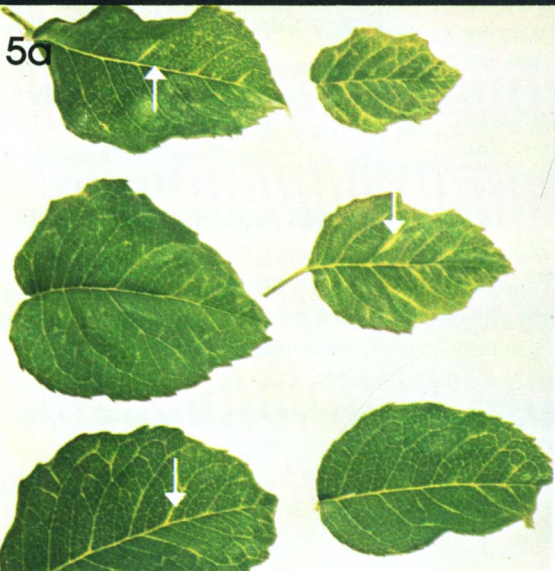
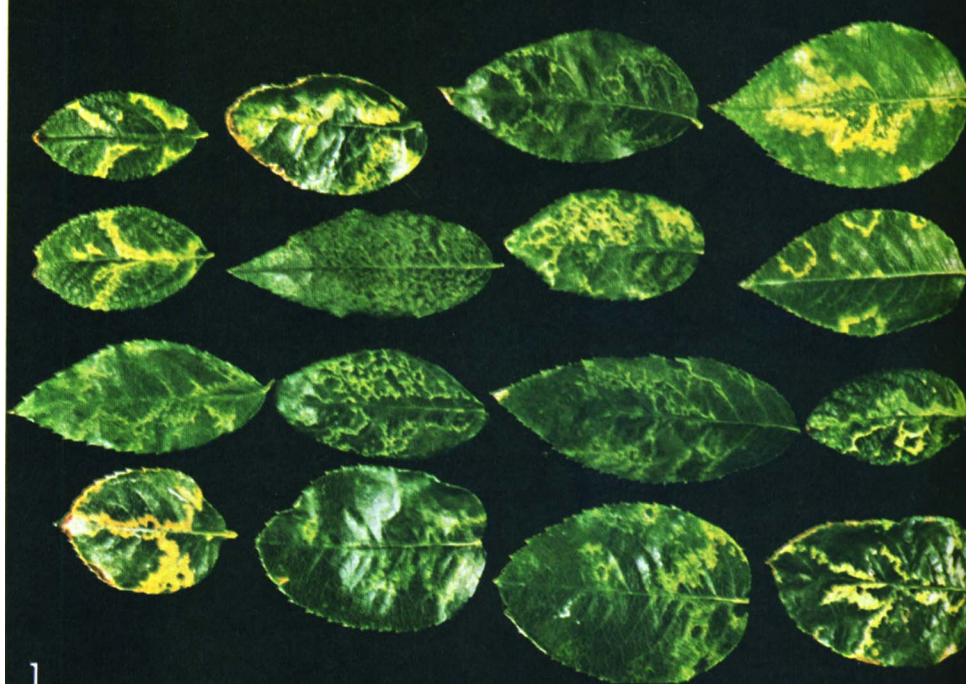


Fig. 1. Leaflets from several rose plants infected with rose mosaic. Note similarity but variation of symptom patterns.

Fig. 2. Hybrid tea rose infected with rose yellow mosaic.

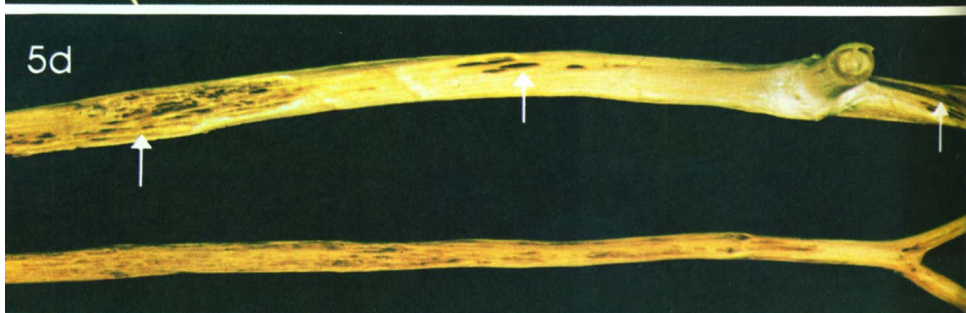
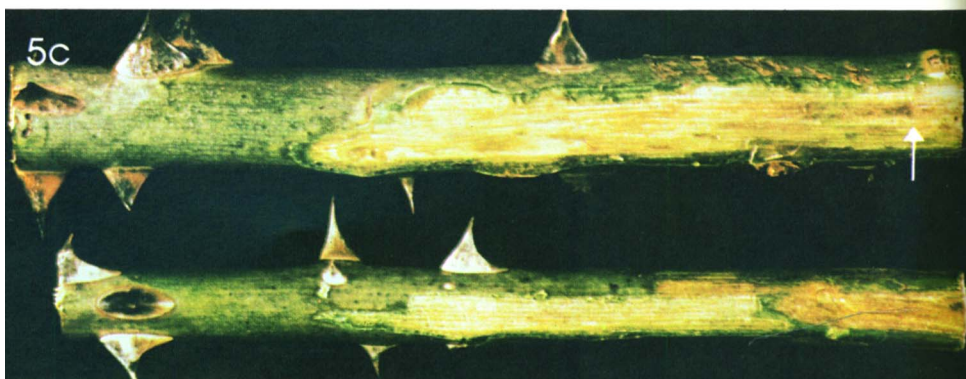
Fig. 3. Rose rosette disease in *Rosa multiflora*. Note misshapen leaves and red pigmentation.

Fig. 4. Rose leaf curl infection in Queen Elizabeth variety. Note downward curling of leaves, leaf drop, and shoot dieback characteristic of this disease.

Fig. 5. Additional rose leaf curl symptoms in hybrid tea roses: (a) flecking of veins; (b) cracking of leaf rachis; (c) discoloration of inner bark in the variety Queen Elizabeth (healthy stem on bottom); and (d) pitting in wood of mature canes.

Fig. 6. (a) Rose spring dwarf symptoms in 'Burr' multiflora rootstock. (b) Closeup of infected bud shoot showing diagnostic vein clearing and balling of leaves.

Fig. 7. Rose X disease: (a) symptoms in hybrid tea roses (note fine line pattern and rings); (b) typical symptoms in *Rosa multiflora* (c) *Rosa multiflora* showing fine line pattern and ring symptoms that may develop, especially in the field; and (d) *Rosa multiflora* plants of same age—RX-infected on right, healthy on left.





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virus-like diseases

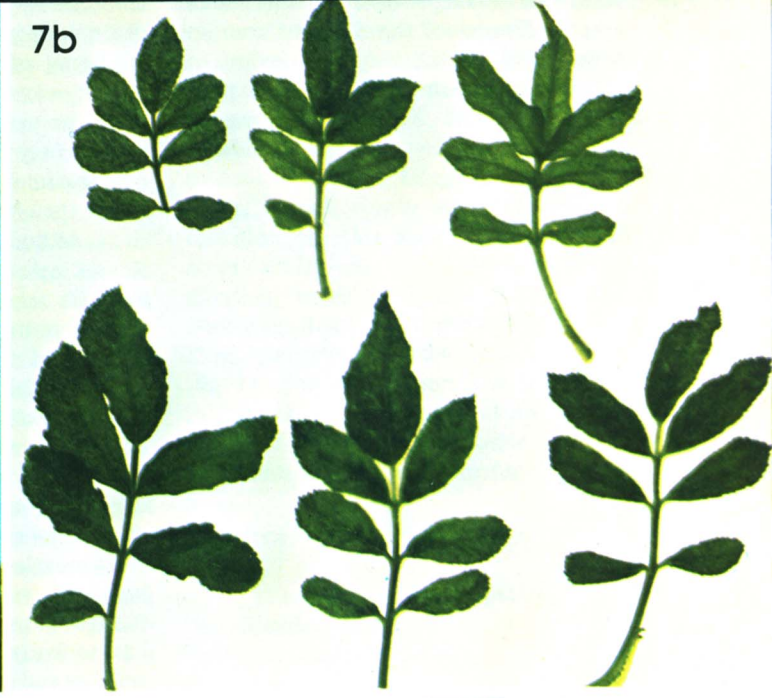
Gary A. Secor ■ Mansun Kong ■ George Nyland



6a



7a



7b



6b



7c



7d

Rose virus . . .

latent or appear only seasonally, so visual inspection of propagation sources alone is not sufficiently accurate to detect all infected plants. Special methods of testing for virus infection, called "indexing," are required to determine the presence or absence of viruses.

Aided by funds from commercial rose growers, plant pathologists at the University of California, Davis, and the California Department of Food and Agriculture, Sacramento, are studying the characteristics and causes of several virus and virus-like diseases and are searching for control methods. Many of these diseases may be widespread because of the worldwide distribution of rose variety budwood.

Six known rose virus and virus-like diseases occur in California. We use the term "virus-like," because the causal agents of some of the diseases have not been identified, although the symptoms and effects are similar to those of virus

diseases of some other plants.

Diseases

The most common disease is rose mosaic, caused by one or more viruses. This is an old disease, which occurs in landscape, nursery, rose garden, and commercial field plantings. Rose mosaic is virtually everywhere in the United States and other countries where roses are grown.

The disease can be recognized by light-green to bright-yellow mosaic patterns on the leaves of infected plants (fig. 1 and 2). Identification of rose mosaic can be confirmed by using the necrotic hypersensitive reaction that infected rose tissue produces when it is budded into the flowering cherry variety *Shirofugen*.

Depending on the rose variety and on variations of the virus, rose mosaic symptoms range from general yellow chlorosis to vein clearing or banding to distinct rings and intricate line patterns. A type of rose mosaic—rose yellow mosaic—causes general yellowing of the leaves or veins. Plants infected with rose mosaic may be somewhat stunted and in colder climates may suffer greater winter injury than healthy plants.

Although rose mosaic virus is considered by many to be a strain of *Prunus* ringspot virus, some rose mosaic symptoms may be caused by different viruses. Serological relatedness has been shown between California rose mosaic isolates and *Prunus* ringspot virus from other hosts.

Rose streak is a suspected virus disease of roses occurring in Europe and North America. In the United States it is most prevalent in the eastern states, but it has been encountered in California, although infrequently. The disease, which has no known vector, is transmissible by grafting and seems to affect only roses.

Diagnostic symptoms include brownish-green rings and vein banding in expanded leaves, accompanied by ring patterns on stems and sometimes on fruit. Premature fall of symptomatic leaves, as well as yellow-green vein banding, may occur on some hybrid multiflora or *wichuraiana* roses. The rose variety *Madame Butterfly* is a sensitive indicator of rose streak. Inoculation of rose-streak-infected buds by grafting to this variety causes necrosis and blackening around the inserted bud soon after the union has been established.

A third disease—rose rosette—in

California has been observed as a natural infection only on wild rose species, but researchers have experimentally transmitted it to cultivated roses by grafting. Rose rosette symptoms in 'Burr' multiflora include leaflet deformation and wrinkling, bright-red leaf pigmentation, witches'-brooming, and phyllody (conversion of flower parts to a leaflike



Prevention—use of virus-free buds and rootstocks—is the only practical means of controlling these rose diseases.

appearance) (fig. 3). This disease has been reported to be caused by a mite-transmitted virus, although the viral etiology has not been proven.

New virus-like diseases

Three virus-like infectious diseases of roses were discovered in California in

recent years. The causal agents have not yet been determined, but all are graft-transmissible and thus important or potentially important to California rose growers. Since no pathogenic organisms, such as bacteria, mycoplasma, or fungi, have been found associated with these diseases, the current hypothesis is that virus or virus-like agents are responsible. Because of the consistent characteristics of the disease syndromes, we believe there are three different agents.

The first disease discovered, now known in California as rose leaf curl (RLC), is widely distributed in the United States. It was found in several community rose gardens in midwestern and southern states in 1976. The symptoms resemble those of rose wilt or dieback, a disease not known to be present in the United States. Although RLC is similar to rose wilt as reported in Australia and New Zealand, not enough is known about the etiology of either disease to draw any conclusions about their relatedness.

Rose leaf curl has been found only in public rose gardens, usually in or near plants of "antique" roses. Recent data indicate a slow natural spread, although the vector is unknown. Hybrid tea roses exhibit RLC symptoms, but rootstock varieties do not. Symptoms on hybrid tea roses are downward curling of leaves on established plants and dieback of canes (fig. 4). Leaves easily drop off new shoots, and the shoots are characteristically pointed with a broad base.

Clearing of sections of secondary veins of newly formed leaves, referred to as "vein flecking," some leaf distortion, corky cracked areas on the rachis and main veins of some leaves, and pitting of the xylem are additional symptoms of rose leaf curl (fig. 5). The inner bark of some canes of most affected hybrid tea plants that we have observed shows brown flecks, streaks, or patches when a shallow cut is made to remove the outer bark (fig. 5). The rose varieties Queen Elizabeth and Madame Butterfly are good indicators of RLC and are useful for indexing.

The second virus-like disease recently found is rose spring dwarf (RSD). This disease may or may not occur simultaneously with RLC. RSD has been found in commercial nurseries, landscape roses, and public rose gardens. No natural spread has been observed.

The disease produces distinctive symptoms when leaves emerge in the spring. The leaves are balled or recurved on very short, arrested shoots and exhibit

conspicuous vein clearing or a netted appearance (fig. 6). The leaves do not drop readily as they do in rose leaf curl. Symptoms disappear later in the growing season but may reappear if canes are defoliated and lateral buds produce new growth.

The agent causing this disease is very heat stable, remaining infectious after treatment *in vivo* for 26 weeks at 38° C. Perpetuation of the disease in varieties by budding and transmission by grafting is erratic. The most reliable indicator of RSD is *Rosa multiflora* 'Burr.'

The third virus-like disease of roses being studied is tentatively called "rose X" (RX) disease. The disease has been found in commercially grown roses in California and Oregon and was discovered during routine screening of varieties for other diseases. No evidence of natural spread has been observed, but graft transmission is nearly 100 percent. The infectious agent has been transmitted to many other varieties, a wild rose (*Rosa rugosa*), and all major rootstocks.

We recently found an association of symptoms in hybrid tea roses with the presence of the RX agent. The only reliable detection method we have at present is indexing using *Rosa multiflora* 'Burr,' which reacts quite violently to infection by this agent. Symptoms on *Rosa multiflora* 'Burr' include severe stunting, small deformed leaflets with dark-green/light-green mottle and wrinkling, and severe shortening of internodes (fig. 7). The agent is sensitive to thermal inactivation in two weeks at 38° C. This disease is similar to rose mosaic, but does not cause necrosis on Shirofugen cherry.

Control

There is no known practical cure for diseases caused by viruses once the infection has occurred. Infection with rose mosaic usually does not sufficiently damage plants to necessitate their removal, but plants infected with rose spring dwarf and rose leaf curl should be removed from the nursery or landscape and destroyed. The ultimate control for virus and virus-like rose diseases is to use virus-free buds and rootstocks.

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