Presence of Green Ring Mottle Virus in Japanese Sweet Cherry

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Introduction

During the years 1966～1967, the author and his coworkers carried out an extensive Shirofugen indexing of commerical peach and sweet cherry mother trees (OBATA et al., 1968). All of the 25 sweet cherry mother trees including Royal Ann, Rockport and Satonishiki cultivars from four orchards in Yamagata Prefecture were free of necrotic ringspot virus and sour cherry yellows virus. Of a total of 24 sweet cherry trees representing an old collection of 14 cultivars from one nursery grower in the same Prefecutre, only five Rockport trees were found to carry sour cherry yellows virus. Similarly, as many as 335 peach mother trees from five different prefectures were tested and only 12 trees of 'Hakuho' cultivar from one orchard in Yamanashi Prefecture were found infected with necrotic ringspot virus. KISHI et al. (1969) also reported unexpectedly low incidence of this virus in commercial peach trees in contrast with unusually high rate of occurrence in stone fruit collections in their experimental plots, particularly in introduced European cultivars.

In the spring of 1967, nine out of a total of 68 Shirofugen indicators that had been used in the previous year for the detection of ringspot virus from domestic and foreign peach and cherry trees expressed a systemic symptom obviously different from the local necrotic reaction of ringspot virus. This symptom consisted mainly of mild to severe epinasty of young spring shoots, suggesting a reaction of this indicator to the sour cherry green ring mottle virus as reported from North America. None of the uninoculated trees exhibited such abnormalities. Hence it was reasonably assumed that green ring mottle virus might have been present in some of the bud sources. Due to a random relocation of the indicator trees in the preceding fall, however, the author's effort to trace the bud sources for these affected trees practically failed, except for the determination that one had received buds from one Satonishiki and seven Napoleon cherry trees in Yamagata Prefecture. Occurrence of green ring mottle virus has not been described in Japan. Therefore, investigations were made to prove the virus nature of the disorder and its identity with the green ring mottle epinasty. Individual re-indexing was also carried out to confirm its presence in sweet cherry trees of Yamagata Prefecture. Unless specifically noted in the text, the present work was conducted with material that was determined to be free of necrotic ringspot and sour cherry yellows viruses on the basis of Shirofugen tests.

Part of this work was presented at the Autumn Meeting of the Kanto Division, Japan Phytopathological Society, held in Tokyo on November 9, 1968.

Epinasty Symptoms of Shirofugen Cherry

Epinasty symptoms on Shirofugen cherry varied widely in severity with individual trees, but it could be roughly separated into mild and severe.

Mild type – Trees are systemically affected. Downward curling of leaves is mild to moderate. Leaf blades sometimes show wavy crinkle along the margins. Appearance of symptoms may be limited to scattered leaves of some of the twigs or branches which may not be the same ones in successive seasons. Shoot growth is nearly normal and tree vigor is not appreciably affected. Leaves that develop later in the season are symptomless. Epinasty is most pronounced in the first season after infection and tends to become more obscure in the succeeding seasons. Four out of nine Shirofugen trees were of such mild type.

Severe type – Extreme downward curling and twisting of leaves are seen as soon as they develop early in spring. These leaf symptoms are always accompanied by necrotic lesions along midribs and main lateral veins of under surfaces. The necrotic lesions then exhibit a pustule-like appearance and often lead to splitting of leaf blades along the veins (Plate D). Affected leaves are usually lighter green than normal and may show chlorotic blotches of irregular shape. The centers of these blotches may, at times, become necrotic and drop out eventually. Affected shoots are extremely dwarfed with short internodes and clustered leaves. The bark of the current-season growth also turns necrotic and becomes progressively roughened by the appearance of brown longitudinal splits (Plate F, G) Such twigs often shed leaves and show rapid dieback from the terminals (Plate B).

The development of epinasty slows down toward the end of June and then enters into a chronic phase. Symptoms in the second year are less acute than in the previous year. Leaf curl and vein necrosis may be milder but misshapen leaves tend to increase. Rough bark on two-year-old twigs becomes more pronounced. Dieback of new and older twigs continues to progress. Tree vigor is extremely reduced and young trees are killed frequently within two to three years. Five out of nine Shirofugen trees could be rated as of this severe type.

Transmission of Shirofugen Epinasty

For the demonstration of the virus nature of Shirofugen epinasty, bud inoculations were made on July 14, 1967 from Shirofugen trees showing epinasty to healthy Kwanzan and Shirofugen indicators. One tree with mild symptoms and four trees with severe symptoms were selected as inoculum sources. For each inoculum source, three one-year-old Kwanzan and two four-year-old Shirofugen trees were used. Three donor buds were inserted into each Kwanzan tree and five buds to each Shirofugen tree. Parallel inoculation was made for comparison with one isolate of green ring mottle virus provided by Dr. Paul R. FRIDLUND, Washington State University, Irrigated Agriculture and Extention Center, Prosser, Washington. Five trees were left uninoculated to serve as control.

The results are given in Tables 1 and 2. Nearly all the inoculated trees expressed symptoms in the following spring, thus demonstrating the presence of a virus entity

involved in the epinasty. Severity of symptoms on Shirofugen was in general similar to that of the corresponding inoculum source. The green ring mottle virus isolate from North America produced severe epinasty on Kwanzan and Shirofugen which was identical to that induced by the severe type inoculum sources No. 2 to No 5. These results indicated that at least the severe type of epinasty was due to green ring mottle virus.

Table 1 GRAFT TRANSMISSION OF SHIROFUGEN EPINASTY TO KWANZAN

Epinasty source	Symptom type (Shirofugen)	Number of inoculated trees	Number of positive transmission	Symptoms observed (Shirofugen)
No. 1	Mild	3	2	Mild curling and twisting, vein necrosis in some leaves
No. 2	Severe	3	1	Severe epinasty with leaf twisting, vein necrosis leading to eventual defoliation
No. 3	Severe	3	3	do
No. 4	Severe	3	3	do
No. 5	Severe	3	3	do
GRMV*		3	3	do
Uninoculated control		5	0	No symptoms

* Green ring mottle virus isolate supplied by Dr. P. R. FRIDLUND, Washington State University, Irrigated Agriculture Research and Extension Center, Prosser, Washington.

Table 2 GRAFT TRANSMISSION OF SHIROFUGEN EPINASTY TO SHIROFUGEN

Epinasty source	Symptom type	Number of inoculated trees	Number of positive transmission	Symptoms observed
No. 1	Mild	2	2	Mild systemic epinasty. Wavy crinkle and occasional chlorotic blotches in leaves. Growth not stunted.
No. 3	Severe	2	2	Severe epinasty. Leaf curling and twisting. Leaves show vein necrosis, chlorotic blotches, shot-holes and often lead to defoliation. Rough bark followed by dieback from terminals. Growth stunting and decline conspicuous.
No. 5	Severe	2	2	do
GRMV		2	2	do
Uninoculated control		5	0	No sympotms

Reaction of Montmorency Cherry

In order to obtain additional evidence of the epinasty virus being green ring mottle virus, virus-free Montmorency cherry was top-budded onto Shirofugen and Kwanzan trees previously inoculated with the epinasty sources No. 1 to No. 5. Parallel top-budding was also made on two healthy and two GRMV-infected Shirofugen trees. In the next growth season, new shoots of Montmorency that developed on the budded trees were closely observed for the appearance of symptoms. The results obtained are listed in Table 3.

Table 3 REACTION OF EPINASTY VIRUS TO MONTMORENCY CHERRY

Epinasty virus source	Montmorency top-budded on:	Number of trees with positive bud-take	Symptoms observed
No. 1 (Mlid type)	Shirofugen	1/2	Green blotches in yellowed leaves typical of GRMV.
	Kwanzan	1/3	Dark blotches and occasional chlorotic spots in some older leaves.
No. 3 (Severe type)	Kwanzan	1/3	Occasional dark blotches in some older leaves.
No. 5 (Severe type)	Shirofugen	2/3	Many green spots in some leaves of senescent stage.
GRMV	Shirofugen	1/2	Green blotches typical of GRMV in some older leaves.
Control	Uninoculated Shirofugen	2/2	No symptoms

All of the Montmorency shoots that grew on infected trees showed dark green or chlorotic blotches with obscure margins in some of the lower leaves from mid- to late June. Some leaves yellowed progressively but, for a biref period before defoliation, retained several conspicuous green spots on the bright yellow background (Plate E) a typical symptom of the green ring mottle virus (OBATA, 1967). Other leaves also yellowed sooner or later and dropped eventually by mid-August. Such affected shoots markedly declined and did not survive the following winter. The Montmorency shoots that grew on healthy Shirofugen developed normally without any sign of the aforementioned symptoms. From the results obtained, it was concluded that the Shirofugen epinasty was caused by green ring mottle virus and that differences between mild and severe type were due to different strains of the virus.

Presence of Green Ring Mottle Virus in Japanese Sweet Cherry

In order to confirm the occurrence of green ring mottle virus in sweet cherry trees in Yamagata Prefecture, 37 cherry trees including 25 trees previously tested in bulk on Shirofugen were indexed individually. A four-year-old Kwanzan tree was used to index each source tree; six inoculum buds were inserted in each indicator tree on August 25, 1967. For the positive control, the North American GRMV isolate was indexed on three Kwanzan trees and, for the negative control, five Kwanzan trees were left uninoculated. Bud union was closely examined one month after inoculation and just prior to the first reading of symptoms in the next spring.

Results with 32 cherry trees from which positive bud union was obtained are shown in Table 4.

Mild epinasty was induced by two Napoleon trees and severe epinasty by one Rockport tree (Plate A). One of the two Napoleon trees was confirmed to be the origin of the mild epinasty of the Epinasty Source No. 1 which was mentioned earlier. These results have provided conclusive evidence for the occurrence of green ring mottle virus in Japanese sweet cherry.

Table 4 DETECTION OF GREEN RING MOTTLE VIRUS FROM SWEET CHERRY TREES IN YAMAGATA PREFECTURE

Cultivar	Orchard	Number of trees indexed	Number of trees infected	Type of symptom
Napoleon (Royal Ann)	A	6	1	Mild
	B	6	0	—
	C	8	0	—
	D	2	1	Mild
	E	5	0	—
Rockport	B	1	0	—
	E	1	1	Severe
Satō-nishiki	A	1	0	—
	B	1	0	—
Zawō-nishiki	E	1	0	—
Total	5	32	3	—

Possible Occurrence of Green Ring Mottle Virus in Japanese Peach

In the Shirofugen test of peach mother trees in 1967 (OBATA et al., 1968), a total of 141 trees including 11 cultivars from Saitama, Chiba and Yamanashi Prefectures were indexed by 26 Shirofugen indicator trees. Two Shirofugen trees on which the ring spot reaction was negative during the previous growth season expressed acutely systemic epinasty in the spring of 1968. The inoculum buds on these affected indicators were from the bulk of seven peach trees of the cultivar 'Hakuho' from Saitama Prefecture. Again in the 1968 season, a total of 58 peach mother trees from Saitama, Chiba and Niigata Prefectures were indexed. In the spring of 1969, severe epinasty was observed on two of the five Shirofugen trees that received buds from peach trees from Saitama Prefecture, and on one of the three indicator trees that indexed peach trees from Niigata Prefecture. Uninoculated Shirofugen trees were normal throughout these seasons. Although the virus source remains to be elucidated by individual indexing, such frequent occurrence of epinasty reactions in the Shirofugen test is strong evidence that green ring mottle virus occurs also in Japanese peach trees.

Reaction of Green Ring Mottle Virus on the Rootstock Variety 'Aohada'

In the spring of 1967, young trees of *Prunus serrulata* variety 'Aohada' that had been budded with one stock of the imported sour cherry cultivar 'English Morello', showed a mild transient epinasty on early developing leaves. Since this stock was found to carry both green ring mottle virus and sour cherry yellows virus, it was suspected that the epinasty of 'Aohada' variety might be at least partly due to the effect of green ring mottle virus. In order to confirm this point, budding inoculations were made on August 7, 1967 from three virulent green ring mottle sources to three of two-year-old 'Aohada' cuttings. As shown in Table 5, all of the inoculated trees expressed moderate leaf curling in the next spring. The growth of new shoots was severely reduced and led to mildly rosetted appearance (Plate C). Compared with the reaction of Kwanzan and

Shirofugen, the symptoms were much milder with less vein necrosis and no chlorotic blotches on the leaves. No rough bark or defoliation was found associated with the development of symptoms. Japanese sweet and flowering cherries are grown exclusively on this rootstock variety. Such sensitivity of the rootstock to this virus, therefore, may have a potentially deleterious consequence upon the growth of infected scion varieties.

Table 5 INOCULATION OF THE ROOTSTOCK VARIETY 'AOHADA' WITH GREEN RING MOTTLE VIRUS

Epinasty virus source	Symptom type	Number of inoculated trees	Number of positive transmission	Symptoms observed
EM-1 (Sour cherry)	Moderate	3	3	Mild and transient downward curling of leaves. Growth not appreciably affected.
No. 3 (Shirofugen)	Severe	3	3	Moderate epinastv with occasional necrosis in midribs. Growth stunted.
GRMV (Sweet cherry)	Severe	3	3	do
Uninoculated control	—	5	—	No symptoms

Stem Pitting of Shirofugen Associated with Epinasty Symptoms

While reading the epinasty symptoms of a number of Shirofugen indicators, the author's attention was caught by frequent encounters with stem pitting on severely affected trees (Plate H, I). This symptom was first observed on two- to three-year-old woods of one tree that was dying back rapidly during the second season after infection. Later, it was also found associated with acute epinasty and resulting rough bark of the current-season growth during the first year after inoculation. In no case, however, did it seem to appear in advance of the onset of epinasty symptom. Such pitting was occasional only, or totally absent, on the trees affected by mild epinasty. Furthermore, no sign of pitting was recognized on the 'Aohada' rootstock of severely pitted Shirofugen trees. Although the presence of stem pitting is not of much diagnostic value, it can be cited as one of the syndromes associated with severe epinasty of Shirofugen indicators.

Discussion

As early as 1942, MILBRATH and ZELLER reported from Oregon a virus disease of flowering cherry, rough bark which produced characteristic epinasty in the Kwanzan cultivar. Only this cultivar was found naturally infected but, upon graft inoculation, the disease also affected Shirofugen to much the same extent and infected two others with slight or little symptoms (MILBRATH and ZELLER, 1942, 1951). Peach and sweet cherry including Bing, Napoleon and Lambert cultivars were described as symptomless hosts. MILBRATH (1952) suspected that the Kwanzan epinasty of varying severity might be caused by mild to severe strains of ringspot virus. Green ring mottle, on the other hand, was described as a virus of sour cherry in Eastern United States and Canada in the late

1930s to early 1940s (RASMUSSEN et al., 1952). The identity of this virus, however, was not clearly defined because of its frequent association with ringspot and yellows viruses. In 1958, FRILDUND and DIENER reported that the virus causing epinasty was distinct from the necrotic ringspot virus and most probably identical with green ring mottle of Montmorency, while in the East of the United States, BARKDSDALE (1959) also proved the green ring mottle virus as an entity distinct from the sour cherry ringspot and yellows viruses as well as its identity with Kwanzan epinasty virus. Their finding was corroborated by MILBRATH in 1960.

In the present studies, the author has provided the first report of the occurrence in Japanese sweet cherry of a virus causing mild to severe epinasty in Kwanzan and Shirofugen indicators. This virus is considered to be green ring mottle virus, because the epinasty symptoms on the flowering cherry indicators and the foliage pattern symptoms on Montmorency cherry correspond well with those described on these hosts in North America. This virus is hitherto unrerpoted from Japan. The severity of epinasty varied with the virus sources but was generally reproducible by successive transfers, thus indicating the presence of mild to virulent strains of the same virus.

Stem pitting was found usually associated with severe epinasty of Shirofugen. This symptom, though not particularly mentioned in reports of earlier workers, can be included as one of the syndromes of this virus on Shirofugen cherry. In recent years, presence of a stem pitting disorder in various stone fruit species has attracted increasing attention of research workers in North America. LOTT et al. (1962) first reported from British Columbia a stem pitting in sweet cherry and apricot in frequent association with gumming and distortion symptoms. He then described an experimental transmission of the stem pitting factor and suggested a name "xylem aberration" for this disease (LOTT, 1967). In the East of the United States, several articles have recently described the occurrence of a severe stem pitting disorder in peach and other *Prunus* species (BARRAT et al., 1968; MIRCETICH et al., 1968, 1969; LEWIS et al., 1968; STOUFFR et al., 1969a, b; DOWLER et al., 1968). A similar stem pitting was also detected from Italian prune in Oregon (CAMERON, 1969) and from peach trees infected with yellow bud mosaic virus in California (SMITH et al., 1969). For the most part, the nature of such disorder must await further elucidation. At the moment, therefore, the stem pitting of Shirofugen as reported here cannot be related to any of the foregoing descriptions. However, the implciation that the green ring mottle virus can incite stem pitting in one of the *Prunus* species may be significant in the light of the increasing importance of this symptom in stone furits in North America.

Prunus serrulata variety 'Aohada' was shown to be moderately sensitive to virulent strains of green ring mottle virus. This variety is readily propagated by cuttings and used extensively as a common rootstock of sweet and flowering cherry in Japan. No apparent effect of green ring mottle virus has so far been recognized on the growth of infected sweet cherry trees in commerical orchards. However, it can be undeniable that the detectable sensitivity of the rootstock variety may, in the long run, exert a potentially deleterious influence upon the life of infected trees.

The epinasty virus is said to be commonly distributed in stone furits in the western

United States, often mixed with the ringspot virus (MILBRATH, 1960). FRIDLUND (1961) has also stated that this virus was common in symptomless sweet and mazzard cherry, *Prunus avium*, and duke cherry, *P. avium* × *P. cerasus*. He also mentioned that certain cultivars of sweet cherry such as Lambert, Deacon and Napoleon were almost universally infected with this virus. Within the scope of the present studies, however, this virus does not appear to be wide-spread in commerical sweet cherry orchards in Japan.

In this paper, evidence was also presented to show the latent distribution of the green ring mottle virus in Japanese peach trees. This was indicated by the repeated encounters with the epinasty in the Shirofugen test of peach trees that had indexed negative for the ringspot virus reaction. Further experimentation is needed to supplement this finding.

Summary

A virus causing epinasty in Kwanzan and Shirofugen flowering cherry indicators was detected in two Napoleon trees and one Rockprot tree in Yamagata Prefecture. Symptoms in the indicators were mild to severe leaf curling, veinal necrosis, stunting of new shoots and rough bark. Furthermore, wood pitting was also found in severely affected Shirofugen trees. On the basis of comparison with a North American isolate, this epinasty virus is identified as sour cherry green ring mottle virus heretofore undescribed in Japan. Presence of mild to severe strains was indicated by the varying degree of symptom severity which was generally reproducible in successive transfers. *Prunus serrulata* variety 'Aohada', a common rootstock of Japanese sweet and flowering cherry, was found to be sensitive to virulent strains of this virus. Evidence is presented to show the latent occurrence of this virus in Japanese peach trees.

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摘　　要

日本のミザクラにおける Green Ring Mottle Virus の存在

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1966年度の国内および輸入核果類のシロフゲン検定に用いたシロフゲン指標個体68本のうち9本に1967年春 epinasty 症状が観察された。病徴を発現した個体は前年度の生育期間中 Ring spot virus による局部えそ反応は陰性であったこと，供試しなかったシロフゲン個体には病徴を生じなかったことなどから，この症状は検定に用いた接種芽に含まれていた Ring spot virus とは異なるウイルスによるものであり，病徴の類似性からおそらく北米で早くから報告されている酸果オウトウの Green ring mottle virus（以下GRMV）であろうと推定された。さらに病徴を発現したシロフゲン個体9本のうち1本は山形県のミザクラ母樹（ナポレオン7本，佐藤錦1本）を芽接した個体であることが判明し，わが国のミザクラにもこのウイルスが潜在的に分布している可能

性が示された。そこでこのシロフゲンの epinasty 症状の接木伝染性を明きらかにするとともに，アメリカから導入した GRMV の1ウイルス株と2～3の標準指標植物における反応を比較検討した結果，日本では従来未記録の GRMV であることを確認した。

① シロフゲンの病徴

Epinasty の程度はシロフゲンの個体によって異なるが，大別して軽症型 (Mild type) と重症型 (Severe type) にわけられる。

軽症型：春の展葉とともに葉が外側にねじれるが，その程度は軽く，葉縁が波状のしゅう伏を示す場合や，発病が樹冠全体におよぶことなく，一部の枝，葉にのみ巻葉を生ずる場合がある。葉脈のえそは少なく，発病枝の伸長生長もほぼ正常である。病徴は4～5月に明瞭であるが，遅れて出る新葉は病徴を消失する。発病2年目の病徴は初年度の病徴より軽く，発病枝は年により一定しない傾向がある。

重症型：4月の展葉とともに葉脈に淡褐色のえそを生じ，葉は激しく外側に巻き，捻転する。葉脈のえそは次第に黒変し，しばしば裂開して葉身は lace leaf 状となる。葉にはまた不斎形の退緑斑点をあらわし，斑点の中心は褐色のえそになり抜け落ちることもある。捻曲やえその著しい発病枝では，葉が枝の先端から下方に進む異常落葉を起し，枝枯れになる。発病枝の樹皮には通常縦長のやゝ隆起した褐色えそがみられ，えそ部は次第に裂けて粗皮症状 (Rough bark) を示す。発病枝は著しく萎縮し，節間がつまる。このような急性の病徴推移はほぼ6月末には終り，その後は慢性型の進展を示す。発病2年目の病徴は巻葉や葉脈えそはやや軽いが，葉数は減少し，奇形葉が増加し，樹勢は衰弱して2～3年で枯死する個体が多い。

このような重症型の病徴を示すシロフゲンには木質部に顕著な stem pitting がみられる。この pitting は発病当年枝にすでに発現し，2～3年生枝や主幹にもみられる。この pitting は葉の epinasty に先行してあらわれるものでなく，たいてい枝の粗皮病状に伴なって発現する。また台木のアオハダザクラの部分には pitting は生じない。

② Epinasty の伝染性と Montmorency cherry に対する反応

シロフゲンの発病個体を選び健全シロフゲンおよびカンザン芽接接種した結果，翌春にはほとんどすべての個体が病徴を発現し，この epinasty がウイルスによるものであることが判明した。発現した病徴は接種源の病徴型をよく再現するところから，本ウイルスには病原性を異にする系統が存在すると考えられる。アメリカから導入した GRMV 株はシロフゲンおよびカンザンに重症型の epinasty を生じた。

Epinasty を生じたシロフゲンおよびカンザンに健全な Montmorency cherry を芽接し，翌春活着伸長した Montmorency 新梢を観察した結果，供試したウイルス源は軽症型および重症型ともに，6月中下旬から葉に退緑斑点もしくは暗緑色の斑点を生じ，一部のウイルス株では葉の黄化につれて鮮明な緑色斑点または輪紋を残す典型的な GRMV の病徴を発現した。病徴は下葉にはじまって上葉に進み，急速に黄化し，8月中旬には落葉した。健全シロフゲンに接いだ Montmorency は新梢の発育良好で，病変は認めなかった。このような病徴およびその推移は比較に用いたアメリカ産の GRMV 株を接種源とした場合によく一致した。この結果からシロフゲンおよびカンザンに epinasty を生ずるウイルスは GRMV であると同定した。

③ 山形県のミザクラからの GRMV 検出

1966年に Ring spot virus を対象としておこなったシロフゲン検定に供試した山形県のミザクラ母樹4品種，32本を1967年に GRMV を対象としてカンザンにより個別検定した結果，ナポレオン2本，高砂1本の保毒樹が発見された。ナポレオンの2本はカンザンに軽症型の epinasty を生じ，前年度シロフゲンに mild epinasty を生じた接種源であることが究明された。高砂の保毒樹1本からカンザンに生じた epinasty は重症型に属するものであった。この結果から，さきに同定した従来わが国では未記録の GRMV が国内ミザクラに潜在的に分布していることが確認された。

④ 日本のモモにおける GRMV 保毒の可能性

1967年度のモモ母樹のシロフゲン検定において埼玉，千葉，山梨各県のモモ11品種，141本を26本のシロフゲンを用いた検定した。このうち埼玉県の白鳳7本を芽接したシロフゲン2個体が1968年の春に著しい epinasty を発現した。さらに1968年には埼玉，千葉，新潟各県のモモ計58本をシロフゲン検定したが，このうち埼玉県のモモを接いだシロフゲン2個体，新潟県のモモを検定した1個体が翌春激しい epinasty を生じた。これらの epinasty のウイルス源はそれぞれ個別検定によって追跡する必要があるが，モモのシロフゲン検定においてこのようにしばしば epinasty が発現することは，日本のモモにも GRMV が潜在している可能性を強く示唆するものと考えられる。

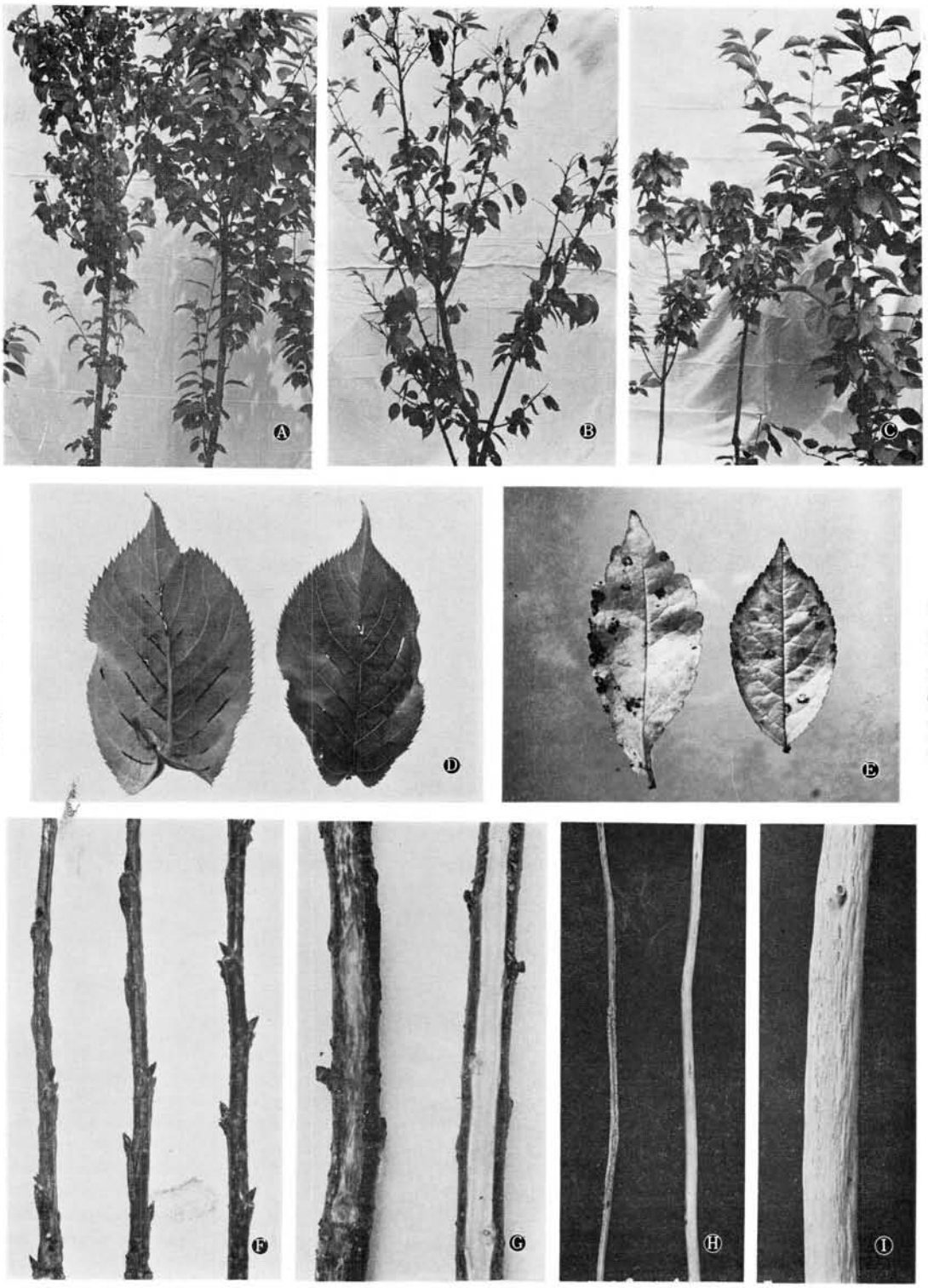
⑤ アオハダザクラの GRMV 感受性

病原性の強い GRMV 2株を芽接接種したアオハダザクラに翌春明瞭な epinasty が観察された。新梢の発育は抑制され，節間はやゝつまって萎縮した外観を呈する

が，葉の捻曲は軽く，葉脈えそも少なく，粗皮症状もみられない。ミザクラ（甘果オウトウ）のGRMV保毒樹では可視的な病徴はみられないが，その台木として一般に用いられているアオハダザクラがこのような感受性を示すことは，注意しておく必要があると思われる。

Explanation of Plate

Plate 1. A: Severe leaf curl of Kwanzan cherry caused by green ring mottle virus in the first season after inoculation; a normal tree on the right. B: Defoliation and dieback of spring shoots of severely affected Shirofugen tree. C: Moderate epinasty and growth stunting of rootstock variety 'Aohada' induced by a virulent strain of green ring mottle virus; a normal uninoculated tree on the right. D: Vein necrosis and resulting splitting of the leaf blades of Shirofugen. E: Typical green rings or blotches on Montmorency leaves affected by green ring mottle virus. F: Longitudinal necrotic bark splitting of the current-season shooots of Shirofugen. One shoot on the right is from healthy treee. G: Bark necrosis of two-year-old twig of Shirofugen. The right twig is normal. H: Stem pits associated with rough bark symptom of the current-season shoot of Shirofugen; a normally developed shoot on the right. I: Severe wood pitting on three-year-old main lateral branch of Shirofugen.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