3rd Arab Congress For Plant Protection
Al-Ain, UAE, Dec. 8 - 9, 1988

Infectious Diseases of Grapevines: Nature, Detection, Sanitation and Situation in the Arab Countries

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Abstract

Martelli,G.P.1989. Infectious diseases of grapevines: nature, detection, sanitation and situation in the Arab countries. Arab J. Pl. Prot. 7: 219 - 210.

An account is given of the present status of virus, virus-like and viroid diseases of the grapevine (*Vitis* spp) in the Mediterranean basin and the Near East, with special reference to the Arab countries. The symptomatology, possible economic impact, geographical distribution, and currently used methods for identifying these diseases are briefly reviewed. The etiological and epidemiological problems still posed by major diseases like leafroll and rugose wood are discussed also in the light of the most recent laboratory acquisitions. Possible ways of prevention and control are outlined.

Introduction

Infectious diseases of grapevines (*Vitis* spp.) are induced by intracellular pathogens of different nature. These diseases are widely distributed through the world, occurring wherever grapevines, especially *Vitis vinifera* are grown. Although their causal agents may be spread in nature by vectors, (i.e. nematodes, pseudococcid mealybugs, leafhoppers and, perhaps, aphids) the major and most efficient way of dispersal is through infected propagating material.

The following types of infectious disorders are known: (i) virus diseases; (ii) virus-like diseases; (iii) viroid diseases; (iv) diseases induced by intracellular prokaryotes.

In recent times, a number of books and papers have reviewed the virological problems of grapevines (Bovey *et al.*, 1980, Martelli, 1986, 1988; Martelli and Prota, 1985; Martelli *et al.*, 1986, Smith *et al.*, 1988; Pearson and Goheen, 1988). To these publications the readers are referred for detailed information.

Virus Diseases

These are induced by recognized viruses which have been isolated, identified and, in some cases, re-inoculated into grapevines, reproducing the natural syndromes. Some 30 different viruses have been identified in infected grapevines. Most of them have been isolated by mechanical inoculation (Table 1); a few, which are restricted to the phloem, have so far resisted manual transmission (Table 2). Not all viruses infecting grapevines are of economic importance as they represent occasional contaminations of vines grown in specific environments.

Some of the major diseases known to date (Table 3) are caused by nepoviruses, of which two main groups can be recognized according to the geographical origin and distribution of both viruses and nematode vectors. Notable exceptions are grapevine fanleaf virus (GFLV) and its major vector *Xiphinema index* which, although probably native to ancient Asia Minor, now have a worldwide distribution because of unrestricted commercial trade.

Closteroviruses are also frequent in grapes and are likely to be involved in the genesis of several diseases, among which leafroll and the rugose wood complex.

1. Fanleaf

Fanleaf is the only degenerative-type nepovirus-induced disease of economic importance in the Mediterranean basin and the near East. It is characterized by two distinct syndromes evoked by different reactions to biologically distinct strains of the same virus (GFLV):

(a) «Infectious malformations» caused by distorting

Table 1. Mechanically transmissible viruses isolated from grapevines, geographical distribution and vectors.

Virus	Geographical distribution	Vector
1. Artichoke Italian latent nepovirus (AILV)	Bulgaria	*Longidorus apulus, Longidorus fasciatus*
2.Alfalfa mosaic virus (AMV)	Europe (Switzerland, Germany, Hungary, Bulgaria, Czechoslovakia)	Aphids
3. Arabis mosaic nepovirus (ArMV)	Europe (Switzerland, Germany, Hungary, Yugoslavia, Bulgaria, France, Italy) Japan	*Xiphinema diversicaudatum*
4. Broadbean wilt fabavirus (BBWV)	Bulgaria, South Africa	Aphids
5. Cucumber mosaic cucumovirus (CMV)	Denmark	Aphids
6. Grapevine Algerian latent tombusvirus (GALV)	Algeria	Unknown
7. Grapevine Bratislava mosaic virus (GBMV)	Czechoslovakia	Unknown
8. Grapevine Bulgarian latent neporvirus (GBLV)	Europe (Bulgaria, Yugoslavia, Portugal) USA (New York)	Unknown
9. Grapevine chrome mosaic nepovirus (GCMV)	Hungary, Yugoslavia	Unknown
10. Grapevine fanleaf nepovirus (GFLV)	Worldwide	*Xiphinema index, Xiphinema italiae*
11. Grapevine line pattern virus (GLPV)	Hungary	Unknown
12. Peach rosette mosaic nepovirus (PRMV)	USA (Michigan) Canada (Ontario)	*Xiphinema americanum, Longidorus diadecturus*
13. Petunia asteroid mosaic tombusvirus (PAMV)	Europe (Germany, Italy, Czechoslovakia)	Unknown
14. Potato X potexvirus (PVX)	Italy	Unknown
15. Raspberry ringspot nepovirus (RRV)	Germany	*Longidorus macrosoma, Longidorus elongatus*
16. Strawberry latent ringspot nepovirus (SLRV)	Germany, Italy, Turkey	*Xiphinema diversicaudatum*
17. Sowbane mosaic virus (SoMV)	Germany, Czechoslovakia	Unknown
18. Tobacco mosaic tobamovirus (TMV)	Europe (Germany, Bulgaria, Italy, Yugoslavia, Soviet Union), USA	Unknown
19. Tobacco ringspot nepovirus (TRSV)	USA (New York)	*Xiphinema americanum*
20. Tomato black ring nepovirus (TBRV)	Germany, Palestine, Canada (Ontario)	*Longidorus attenuatus Longidorus elongatus*
21. Tomato ringspot nepovirus (TomRSV)	USA (California and New York) Canada (Ontario)	*Xiphinema californicum Xiphinema americanum*
22. Tobacco necrosis necrovirus (TNV)	South Africa	*Olpidium brassicae*

Table 2. Non mechanically transmissible viruses associated with grapevine leafroll and / or rugose wood complex.

Virus	Vector
1. Grapevine closterovirus A (GVA)	*Pseudococcus longispinus* *Planococcus citri* *Planococcus ficus*
2. Grapevine closterovirus type 1 (GC1V – 1)	Unknown
3. Grapevine closterovirus type 2 (GC1V – 2)	*P. longispinus* (*)
4. Grapevine closterovirus type 3 (GC1V – 3)	*P. longispinus* *P. ficus*
5. Grapevine closterovirus type 4 (GC1V – 4)	Unknown
6. Grapevine virus isometric (GVI)	Unknown

Except for GC1V – 4 whose distribution is unknown, all other viruses have been recorded from several countries of Europe, America, Asia and Africa.

(*) Unpublished data by Dr. B. Rosciglione

strains: Leaves are variously and severely distorted, asymmetrical, puckered and with acute dentations. Chlorotic mottling may sometimes accompany foliar deformations. Canes are also malformed showing abnormal branching, double nodes, short internodes, fasciations and zigzag growth. Bunches are reduced in number and size, ripen irregularly, have shot berries and poor berry setting. Foliar symptoms develop early in the spring and persist through the vegetative season although some masking may occur in summer.

(b) «Yellow mosaic» caused by chromogenic strains. Affected vines show chrome-yellow discolorations that develop early in the spring and may affect all vegetative parts of the vines (leaves, canes, tendrils, inflorescences). Chromatic alterations of the leaves vary from a few scattered yellow spots, sometimes appearing as rings or lines, to variously extended mottling of the veinal and /or interveinal areas, to total yellowing. In spring, affected plants in a vineyard can readily be spotted from a distance. Very little, if any, malformation of the foliage and canes is produced but clusters may be smaller than normal and with shot berries. In hot climates, summer vegetation resumes the normal green color whilst the yellowing of the old growth turns whitish and tends to fade away.

Distorting and chromogenic strains of GFLV are serologically uniform except for a strain recently isolated in Tunisia which is serologically distinguishable from ordinary GFLV strains and from arabis mosaic nepovirus (ArMV), which is also serologically related but distinct from GFLV (Savino *et al.,* 1985 a). All strains are efficiently transmitted in nature by the longidorid nematode *Xiphinema index* which is a much better vector than *X. italiae* (see review by Martelli and Taylor, 1989).

Table 3. Infectious diseases of the grapevine and associated viruses.

Disease	Geographical distribution
1. Infectious degenration complex	
a. Fanleaf and related syndromes	Worldwide
b. Diseases induced by European nepoviruses	Europe, occasional records in Asia
2. Grapevine decline (American nepoviruses)	USA (mostly northern States) Canada
3. Yellow vein (Tomato ringspot virus, California strain)	USA (California)
4. Yellow blotching (Alfalfa mosaic virus)	Europe (Central and Eastern)
5. Line pattern (Grapevine line pattern virus)	Hungary
6. Yellow dwarf (Tomato spotted wilt virus)	Taiwan
7. Leafroll complex: syndromes characterized by more or less intense rolling of the leaves accompanied by yellowing or different patterns of reddening of the leaves	Worldwide
8. Rugose wood complex	
a. Rupestris stem pitting	Worlwide
b. Corky bark	
c. Kober stem grooving	
4 or 5 different closteroviruses and one or more phloem-limited viruses with isometric particles may be involved in the etiology of the above diseases.	
9. Enations	Europe, USA (California), Venezuela, South Africa, New Zealand Australia, Turkey
10. Fleck	Probably worldwide
11. Vein necrosis	Europe, Mediterranean basin, USA (California)
12. Vein mosaic	Europe, Australia
13. Summer mottle	Australia
14. Asteroid mosaic	USA (California)

The impact of the disease on the crop varies with the host species and cultivar and with the severity of the virus strain. Mild GFLV strains may not visibly affect neither the vigour nor the yield of infected vines, whereas severe strains may cause progressive decline of the vines, low yields (up to 80% reduction, see Rudel, 1985), poor fruit quality, shortening of the productive life of the vineyard, low proportion of graft «take», reduced rooting ability of propagating material and decreased resistance to adverse climatic conditions (Bovey *et al.*, 1974; Hewitt, 1980).

2.Leafroll

Affected vines may be smaller than the healthy ones. Major external symptoms are downward rolling of the leaves accompanied by reddish or yellow discolorations of the blades. Discolored areas appear in the interveinal spaces of the lower leaves in early summer, becoming progressively stronger and extended so as to cover, with time, the whole foliar surface. The main veins may or may not retain the green color in the advanced stages of the disease. Ripening of the fruits is affected. At harvest time bunches are smaller than normal and may remain greenish or whitish when berries of healthy vines assume a normal color. Grapes of certain cultivars (e.g. Cardinal, Emperor) may become unmarketable because of the pale coloring of the berries.

Leafroll is latent in American rootstocks but symptoms are often difficult to detect also in *V. vinifera* varieties affected by mild forms of the disease.

Leafroll causes chronic damage. Yield losses averaging 20% but with peaks of up to 70%, occur each year for as long as the infected vines stand in the vineyard. Moreover, there is a reduction of the sugar content of up to 13° Oechsle. Graft «take» and rooting ability of the canes are also reduced, whereas susceptibility to frost injuries is increased (Goheen, 1970).

Although there is mounting evidence that leafroll is a virus disease, the causal agent (s) has not yet been identified. Several closteroviruses and an isometric non mechanically trasmissible virus have been found associated with leafroll-affected vines (Table 2). Records of these viruses exist from virtually all major grape-growing regions of the world (see review by Tanne, 1985) and much circumstantial evidence points to their involvement in the etiology of the disease. However, since the same range of viruses is found in vines affected by rugose wood, a disorder which very often coexists with leafroll in the same plants, none of the viruses in question can yet be identified for certain as a specific agent of leafroll.

Several species of pseudococcid mealybugs (Table 2) have been reported as experimental vectors of some of the grape closteroviruses (see among others Rosciglione *et al.*, 1983, Rosciglione and Castellano, 1985) and are strongly suspected to spread these viruses from vine to vine in nature.

3. Rugose wood

Diseased vines may be undersized, less vigorous than normal and show delayed bud opening in spring; some decline and die within a few years of planting. Grafted vines often show a swelling above the bud union and a marked difference between the relative diameter of scion and rootstock. Sometimes, especially in certain cultivars (e.g. Italia), that bark above the graft union is exceedingly thick and corky, has a spongy consistence and a rough appearance. The woody cylinder is typically indented with pits and grooves that correspond to peg- and ridge-like protrusions on the cambial face of the bark. These alterations may occur on the scion, rootstock or both, according to the cultivar /stock combination and, perhaps, to individual susceptibility. The disease is usually latent in non grafted vines and, sometimes, remains latent also in grafted plants. Similarly, no specific symptoms are seen on the foliage but the bunches may be fewer and smaller than normal.

The economic importance of rugose wood is potentially very high. The severity of damage depends upon scion /stock combinations and their relative susceptibility. On the most sensitive combinations the disease can be destructive, leading to decline and death of the vines. Decline is accompanied by a progressive reduction of the yield (up to or above 50%), which is most severe when wood pitting is present in both scion and rootstock (Garau *et al.*, 1985; Savino *et al.*, 1985 b).

Rugose wood is a complex disease made up, as far as is currently known, by at least three different disorders: (i) Rupestris stem pitting; (ii) corky bark; (iii) Kober stem grooving. Unfortunately, individual diseases cannot be distinguished from one another in the field owing to the absence of specific differential symptoms. Discrimination is possible only by using *Vitis* indicators whose responses can be summarized as follows:

(a) Rupestris stem pitting. In *Vitis rupestris* St. George, it induces a distinctive basipetal pitting limited to a strip extending downwards from the point of inoculation. LN 33 and Kober 5BB do not show modifications of the woody cylinder (Goheen, 1988, Savino *et al.*, 1989).

(b) Corky bark. It elicits grooving and pitting in all parts of the stem of *V. rupestris* and LN 33, but not in Kober 5BB. In LN 33 stem symptoms are accompanied by proliferation of secondary phloem tissues giving rise to typical internodal swellings with a cracked surface. Infected LN 33 indicators are severely stunted, and may show early reddening and rolling of the leaves. The canes ripen irregularly or not at all, and the vines may die within a year (Beukman and Goheen, 1970).

(c) Kober stem grooving. It elicits a marked grooving of the stem of Kober 5BB but not no wood symptoms in *V. rupestris* and LN 33 (Savino *et al.*, 1989; Garau and Prota, 1989).

Wood symptoms appear one to three years after grafting. Chip-bud grafting is recommended for a clear-cut expression of Rupestris stem pitting symptoms which, in this case, develop below the bud union towards the roots.

The etiology of rugose wood is now considered to be viral, but the causal agent (s), likely being one or more of the phloem limited non mechanically transmissible viruses of Table 2, has not yet been identified.

Virus - Like Diseases.

These are induced by unidentified agents that occur in the host tissues, are perpetuated through propagating material and transmitted by grafting. Some are latent (e.g. gleck and vein necrosis) or semilatent (e.g. vein mosaic and enations) in *V. vinifera,* so that they can only be detected by graft-inoculation to appropriate indicators (Table 7). None has a recognized vector or is known to spread naturally in the field.

1. Enations

This disease derives its name by the presence of a peculiar characterizing foliar symptom constituted by enations, i.e. straight or sinous lamellar, leaf-like outgrowths of the lower surface of the blade, mostly running parallel to the main veins. Enation-bearing leaves may be severely mis-shapen, lobate, distorted, and deeply laciniated. When enations are not shown, as it occurs with certain varieties and in certain years, the basal leaves are dwarfed, rounded, thicker than normal, and with prominent veins. The shoots of affected vines tend to grow downwards, without being flexible or rubbery and are variously malformed, especially in the basal part. Symptom expression is erratic and inconsistent but when symptoms are shown, the vines are readily identified in the field because of the delayed bud breaking and the bushy growth in the early stages of vegetation.

The impact of enation disease on the yield may be remarkable. In certain cultivars (e.g. Italia) symptomatic vines suffer crop losses of up to 50% and the detrimental effect is perpetuated, though to a lesser extent, in years when symptoms are not shown (Prota *et al.*, 1982).

2. Fleck

Fleck is latent in all European grape cultivars and all American rootstocks, except for *V. rupestris,* in which it induces a clearing of the veinlets, upward curling and deformation of the leaves. Symptomatic leaves are also smaller and the plant growth is reduced. Its economic importance, if any, is unknown as is the vector. The disease is disseminated through infected propagating material, with no evidence of natural spread.

3. Vein necrosis

Vein necrosis is latent in all European grape cultivars and American rootstocks, except for the hybrid 110 R which is used as an indicator. Necrosis of the veinlets, clearly seen on the underside of the leaf blade, develops first in the leaves at the base of the shoots, and then, as the shoots grow, in the younger leaves. With time, necrotic spots also appear on the upper side of the leaf blade. Severe forms may induce necrosis of tendrils and dieback of green shoots. An almost complete cessation of the growth ensues and the vines may die. Dissemination is through propagating material with no evidence of natural spread.

4. Vein mosaic

Most European grape cultivars seem to be infected symptomlessly. When symptoms occur, they consist of a clearing of the tissues adjacent to the main veins, which may invade part of the interveinal areas. Symptomatic leaves are not mis-shapen or smaller than normal. Similar symptoms are induced in Australia by a disease locally called «grapevine summer mottle», which is regarded as distinct from European vein mosaic (Woodham and Krake, 1983). Vein mosaic is disseminated with propagating material, with no evidence of natural spread.

Table 4. Viroids of the grapevine.

Viroid	No. of nucleotides	Geographical distribution
1. Hop stunt, grapevine strain	297	Japan, Europe, Australia, USA
2. Grapevine yellowspeckle	367	Probably worldwide
3. Citrus exocortis A	371	Europe, Australia
4. Grapevine viroid 2	> 350	Europe, USA
5. Grapevine Australian	369	Australia
6. Grapevine 1b	363	Australia

Viroid Diseases

In less than four years since the first record of a viroid-like RNA in the grapevine (Shikata *et al.,* 1984), six different such RNA molecules, three of which now identified as authentic viroids (Sano *et al.,* 1985; Garcia Arenal *et al.,* 1987; Rezaian *et al.,* 1988), have been detected (Table 4).

Viroids do not occur in seedlings but are widely spread in commercial rootstocks and varieties of European grapes to the extent that most, if not all, propagating material is infected by one or more of them (Flores *et al.*, 1985; Semancik *et al.*, 1987; Rezaian *et al.*, 1988; Szychowski *et al.*, 1988). Viroidal associations are very frequent, the most common being a mixture of the grapevine strain of the hop stunt viroid (HSVd-g) and grapevine yellow speckle viroid (GYSVd) (Semancik *et al.,* 1987; Szichowski *et al.,* 1988; Minafra, 1989).

Of the six viroids known to date, only GYSVd seems to be pathogenic to European grapes in which it induces yellow speckle disease, a disorder described years ago in Australia (Taylor and Woodham, 1972). According to a recent study (Krake and Woodham, 1983) GYSVd is also implicated in the etiology of a disease known as vein banding, which has been for long time regarded as part of the fanleaf disease (Goheen and Hewitt, 1972).

Vein banding is a foliar disorder that induces chrome-yellow flecking of the tissues along the main veins, sometimes spreading into the interveinal areas. Contrary to GFLV-induced yellow discolorations, vein banding symptoms appear in the hight of summer on a limited number of mature leaves and remain visible for the rest of the vegetative season. Although vein banding symptoms may be seen in GFLV-free vines (Prota *et al.,* 1985), they are very often associated with GFLV infections. In fact, it has been suggested that the presence of GFLV enhances vein banding symptom expression (Krake and Woodham, 1983).

Table 5. Virus and virus-like diseases of the grapevine in Mediterranean area and the Near East.

Country	Fanleaf	Leafroll	Rugose wood	Fleck	Enations	Vein necrosis	Vein mosaic	Viroids
Europe	+	+	+	+	+	+	+	+ (3 to 4)
Morocco	+	+	+	+	−	−	−	
Algeria	+	+	+	+	−	−	−	
Tunisia	+	+	+	+	−	−	−	
Malta	+	+	+	−	−	−	−	
Egypt	+	+	+	−	−	−	−	Outside of Europe, some viroids like the grapevine strain of hop stunt viroid and grapevine yellow speckle viroid are likely to occur in all countries
Palestine	+	+	+	+	+	+	+	
Jordan	+	+	+	−	−	−	−	
Albania	+	+	+	+	+	−	−	
Greece	+	+	+	+	+	+	−	
Cyprus	+	+	+	+	−	+	−	
Turkey	+	+	+	+	+	−	−	
Iran	+	−	−	−	−	−	−	
Afghanistan	+	−	−	−	−	−	−	
Syria	No direct information. However, the situation may not differ much from that of neighbouring countries							
Libya								
Lebanon								
Iraq								
Saudi Arabia								
Gulf Countries								
Yemen A.R								
Yemen P.D.R								

Disease Situation in the Arab Countries

Except for diseases induced by intracellular prokaryotes, which have never beendetected in the Near East, it seems that all virus diseases (i.e. fanleaf, leafroll and rugose wood) occur in the region, as shown in Table 5.

This table summarizes the information stemming from visual evidence obtained directly from field surveys, complemented by the scanty data available from the literature. This explains why so little is known on the occurrence and distribution of latent and semilatent virus-like diseases, with the exception of fleck, whose presence is evidenced in the field by self-indexing *V. rupestris* rootstocks.

All Arab countries that have been surveyed so far, seem to have comparable patterns of disease distribution and prevalence: (i) extremely high incidence of diseases in varietal collections (which are too often used as source of material for the establishment of new plantings) and commercial vineyards, especially those established with grafted cultivars of European origin, even when these were introduced in the country long time ago; (ii) relative apparent freedom from symptoms of self-rooted vineyards established with traditional (native) varieties. However, such favourable field impression requires backing by appropriate indexing to ascertain to what an extent freedom from symptoms equals freedom from infection.

The preliminary results of laboratory tests indicate that GFLV is consistently associated with distorting and chrome yellow alterations in Morocco, Algeria, Tunisia, Egypt and Jordan. Vines from the same countries with symptoms of leafroll or rugose wood, contain mixtures of

Table 7. Indicators for grapevine diseases.

Disease	Indicator
1. Fanleaf	*Vitis rupestris* St. George
2. Leafroll complex	Red-berried *Vitis vinifera* cultivars such as: Pinot noir, Cabernet franc, Cabernet sauvignon, Gamay Rouge de la Loire, Mission. Baco22A(Stunting component)
3. Rugose wood complex	
Rupestris stem pitting	*V. rupestris* St. George
Corky bark	LN 33
Kober stem grooving	*V. riparia* × *V. berlandieri* Kober 5 BB
4. Enations	LN 33
5. Fleck	*V. rupestris* St. George
6. Vein mosaic	*V. riparia* Gloire de Montpellier
7. Vein necrosis	*V.berlandieri* × *V. rupestris* 110 R
8. Asteroid mosaic	*V. rupestris* St. George
9. Yellow speckle (viroid)	Mission

Table 8. Methods currently used for sanitation of grapevines.

Method	Pathogen eliminated	Efficiency
1. Heat treatment of whole vegetating plants	Viruses, virus-like agents, prokaryotes	+
2. Heat treatment of newly grafted buds	Viruses, virus-like agents, prokaryotes	+ +
3. Meristem tip culture *in vitro*	Viruses, virus-like agents, prokaryotes, viroids	+ + +
4. Micrografting	Virus, virus-like agents, prokaryotes viroids	+ + + (?)

Disease Identification

As shown in Table 6, a number of methods are available for the identification of intracellular pathogens of grapevines and the diseases they induce (Martelli, 1979). A ponderous literature has accumulated on the technical aspects of detection procedures, illustrating their advantages and drawbacks, and the specific usefulness for grapevine pathogens.

Laboratory diagnosis is of paramount importance for quick and reliable identification of disease agents and, for some of them (e.g. non mechanically transmissible viruses and viroids) it cannot be done without. However, despite the great technological advances that have made biologic-

Table 6. Methods currently used for the detection of intracellular pathogens of the grapevine.

Method	Pathogens detected
1.Transmission by sap- inoculation to herbaceous hosts, backed by serology (conventional, Elisa)	All mechanically transmissible viruses
2.Serology: conventional, Elisa with mono- and / or polyclonal antibodies, immunoelectron microscopy (IEM, ISEM)	All mechanically transmissible viruses. Non mechanically transmissible closteroviruses and other viruses, mycoplasma- like organisms and fastidious bacteria, provided that antisera are available
3.Molecular hybridization	Viroids, non mechanically transmissible viruses
4.Polyacrylamide gel electrophoresis (PAGE)	Viroids, dsRNA forms of closteroviruses
5.Indexing using *Vitis* indicators	All virus and virus-like diseases

closteroviruses yet to be identified.

No specific search for viroids has been carried out; however, vein banding symptoms have been observed in each of the countries surveyed.

It can then be concluded that the sanitary status of grapevines in the Near East is comparable to that of Europe, which calls for the urgent launching of sanitary improvements programs to be adapted to the local conditions and requirements.

al engineering techniques available even to average laboratories, indexing with *Vitis* indicators remains the unsurmounted procedure for sorting out diseases. Most, if not all, infectious disorders of grapevines can be identified with a good to a very high level of confidence using a series of seven indicators (Table 7) to be inoculated by grafting.

Disease Control

Among the various measures that can be used for an integrated control strategy (for review see Bovey, 1981; Martelli, 1982), sanitary selection (Figure 1) and sanitation (Table 8) are the most widely applied, and those on which the major viticultural countries are basing their sanitary improvement programs. These measures may not represent the ultimate solution of the virological problems of grapevine for they are mere means for obtaining virus-or virus disease-free material, whose health must be preserved afterwards. However, the procedures are simple to use and do not require sophisticated equipment nor highly advanced skills. There is only need for adequate infrastructures and a sound organization that any Government with the help, wherever feasible, of grower's associations, should be able to put together at a relatively low cost.

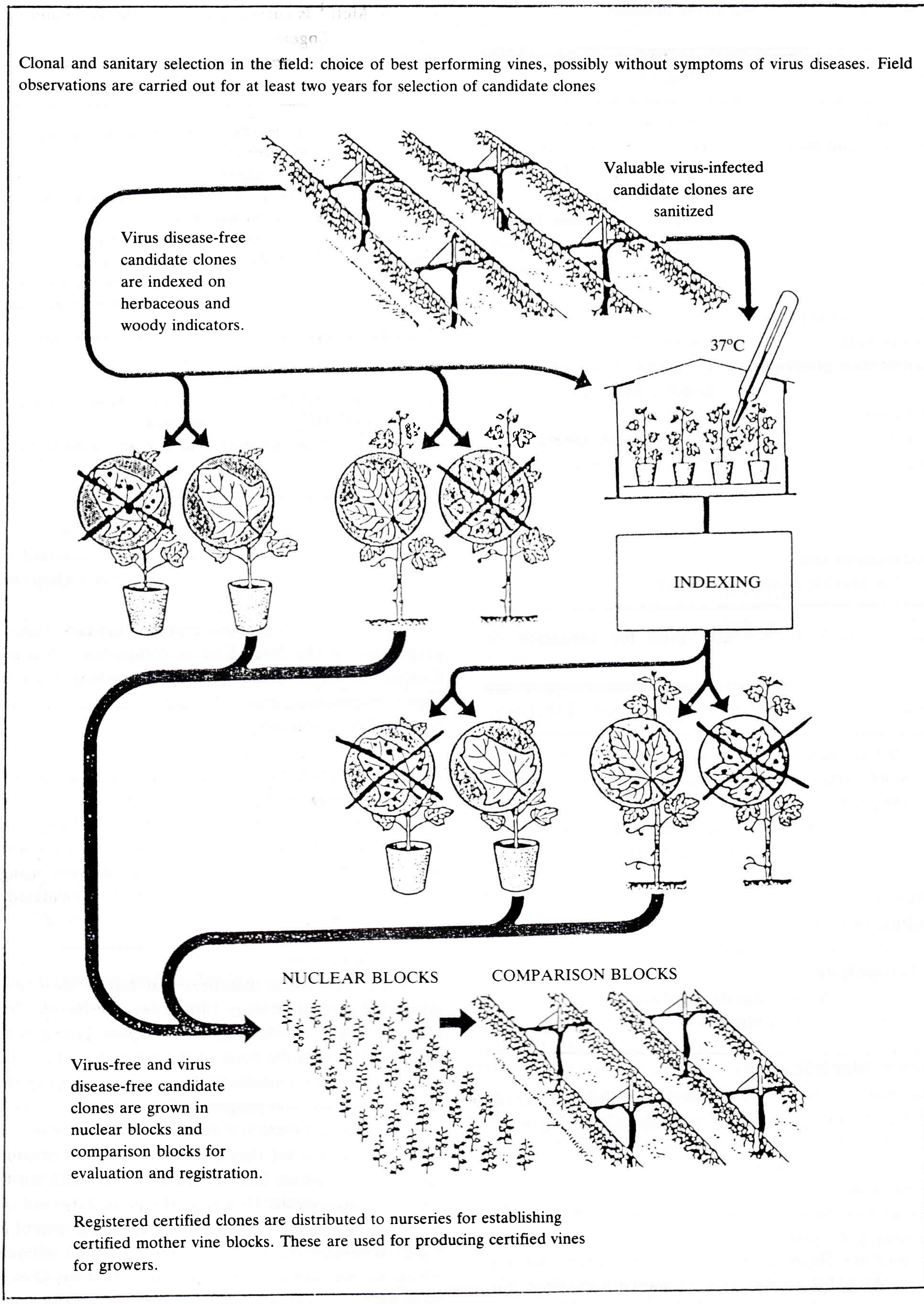

Figure 1. Possible scheme for sanitary improvement of grapevines.

الملخص

مارتيللي، ج. ب. 1989. أمراض كرمة العنب المعدية: طبيعتها، طرائق الكشف عنها، الحالة الراهنة، والوضع الصحي لهذه الأشجار في الدول العربية. مجلة وقاية النبات العربية 7: 219 - 210.

تـم وصـف الحالة الراهنة للأمراض الفيروسية وشبه الفيروسية و «الفرويدية» Viroid التي تصيب كرمة العنب في منطقة حوض البحر الأبيض المتوسط والشرق الأدنى، مع تركيز خاص عن هذه الحالة في الدول العربية. كما أجريت دراسة مرجعية وجيزة عن الأعـراض التي تحدثهـا هذه الأمـراض، وأهميتها الاقتصـادية، وتـوزعها الجغـرافي، والطرائق المستخدمة حالياً في التعرف عليها. ونوقشت أيضاً مشكلات العوامـل المسببة والمشكـلات الوبـائية، غيـر المحلولة، لبعض الأمراض الـرئيسة، كـالتفاف الأوراق والخشب المجعّد، وذلك على ضوء أحدث المعـطيات المختبراتية. كما تمت الإشارة إلى السبل الممكنة للوقاية من هذه الأمراض ومكافحتها.

References

المراجع

1. Beukman, E.F. and A. C., Goheen. 1970. Grape corky bark. In: **Virus diseases of small fruits and grapevines** (N.W. Frazier, ed.) Div. Agric. Sci., Berkeley: 207 - 209.
2. Bovey, R., 1981. Aspects de la selection sanitaire de la vigne. 3rd Intern. Symp. Clonal Selection Vines, Venice 1981: 293 - 301.
3. Bovey, R., W. Gartel, W.B. Hewitt, G.P. Martelli, and A. Vuittenez. 1980. Virus and virus-like disease of the grapevine. Editions Payot, Lausanne, 181 pp.
4. Flores, R., N. Duran Vila, V. Pallas and J.S. Semancik. 1985. Detection of viroid and viroid-like RNAs from grapevine. J. Gen. Virol. 66: 2095 - 2102.
5. Garau, R. and U. Prota. 1989. Researches on wood disorders (stem pitting and/or stem grooving) of grapevine in Sardinia. Proc. 9th Meeting ICGV, Jerusalem 1987 (in press).
6. Garau, R, M. Cugusi, M. Dore, and U. Prota. 1985. Investigations on the yield of «Monica» and «Italia» vines affected by legno riccio (stem pitting). Phytopath. Medit. 24: 64 - 67.
7. Garcia Arenal, F., V. Palas, and R. Flores. 1987. The sequence of a viroid from grapevine closely related to severe isolates of citrus exocortis viroid. Nucleic Ac. Res. 15: 4203 - 4210.
8. Goheen, A.C.. 1970. Grape leafroll. In: **Virus diseases of small fruits and grapevines** (N. W. Frazier, ed.). Div. Agr. Sci. Berkeley: 209 - 212.
9. Goheen, A.C.. 1988. Rupestris stem pitting. In: **Compendium of grape diseases** (R. C. Pearson and A.C. Goheen, eds), Am. Phytopath. Soc. Press, St. Paul: 53.
10. Goheen, A.C. and W.B. Hewitt. 1962. Vein banding, a new virus disease of grapevine. Am. J. Enol. Vitic. 13: 73 - 77.
11. Hewitt, W.B.. 1980. Viruses and virus diseases of the grapevine. Rev. Appl. Mycol. 47: 433 - 455.
12. Krake, L.R. and R.C. Woodham. 1983. Grapevine yellow speckle agent implicated in the aetiology of vein banding disease. Vitis 22: 40 - 50.
13. Martelli, G.P.. 1979. Identification of virus diseases of grapevine and production of disease-free plants. Vitis 18: 126 - 137.
14. Martelli, G.P. 1982. Recent studies on virus diseases of grapevine in Europe with special reference to Italy. Proc. Grape Wine Centenn. Symp. Davis 1980: 28 - 35.
15. Martelli, G.P. 1986. Virus and virus-like diseases of the grapevine in the Mediterranean area. FAO Pl. Prot. Bull. 34: 25 - 42.
16. Martelli, G.P.. 1988. Rècents progrès de la virologie de la vigne. 68e Assemblée gen. Office Intern. Vigne Vin, Paris 1988: 25 pp.
17. Martelli, G.P. and U. Prota. 1985. Virosi della vite. Ital. Agric. 122: 201 - 228.
18. Martelli, G.P. and C.E. Taylor. 1989. Distribution of viruses and their nematode vectors. In: **Advances in disease vector research** (K. F. Harris, ed.), Springer Verlag, New York (in press).
19. Martelli, G.P., A. Graniti, and G.L. Ercolani. 1986. Nature and physiological effects of grapevine diseases. Experientia 42: 933 - 942.
20. Minafra, A.. 1989. Viroidi della vite. Primi risultati di una indagine in corso in Puglia. Inf. tore Fitopatol. 39 (in press).
21. Pearson, R.C. and A.C. Goheen. 1988. Compendium of grape diseases. Am. Phytopath. Soc. Press St. Paul. 93 pp.
22. Prota, U., R. Varau, and M. Cugusi. 1982. Investigations on the quantitative aspects of the yield of grapevines affected by enation disease in Sardinia. Proc. 7th meeting ICVG, Niagara Falls, 1980: 41 - 49.
23. Prota, U., R. Garau, M. Cugusi, and M. Dore. 1985. Investigations on a vein banding diseases of grapevine in Sardinia. Phytopath. Medit. 24: 24 - 28.

24. Rezaian, M.A., A.M. Koltunow, and L.R. Krake. 1988. Viroids in grapevine: detection and isolation. 2nd Meeting Intern. Viroid Work. Group, Yamanashi 1988: 9 – 11.

25. Rosciglione, B. and M.A. Castellano. 1985. Further evidence that mealybugs can transmit grapevine virus A. Phytopath. Medit. 24: 186 – 188.

26. Rosciglione, B., M.A. Castellano, G.P. Martelli, V. Savino, and G. Cannizzaro. 1983. Mealybug transmission of Grapevine virus A. Vitis 22: 331 - 347.

27. Rudel, M. 1985. Grapevine damage induced by particular virus-vector combinations. Phytopath. Medit. 24: 180 – 182.

28. Sano, T., I. Uyeda, E. Shikata, T. Meshi, T. Ohno, and Y. Okada. 1985. A viroid-like RNA isolated from grapevine has a high sequence homology with hop stunt viroid. J. Gen. Virol. 66: 333 – 338.

29. Savino, V., C. Cherif, and G.P. Martelli. 1985 a. A natural variant of grapevine fanleaf virus. Phytopath. Medit. 24: 29 – 34.

30. Savino, V., D. Boscia, D. Musci, and G.P. Martelli. 1985 b. Effect of legno riccio (stem pitting) on «Italia» vines grafted onto rootstocks of different origin. Phytopath. Medit. 24: 68 – 72.

31. Savino, V., D. Boscia, and G.P. Martelli. 1989. Rugose wood complex of grapevine: can grafting to *Vitis* indicators discriminate between diseases?. Proc. 9th Meeting ICVG, Jerusalem 1987 (in press).

32. Semancik, J.S., R. Rivera Bustamante, and A.C. Goheen. 1987. Widespread occurrence of viroid-like RNAs in grapevine. Am. J. Enol. Vitic. 38: 35 – 40.

33. Shikata, E., T. Sano, and I. Uyeda. 1984. An infectious low molecular weight RNA detected in grapevines by molecular hybridization with hop stunt viroid cDNA. Proc. Japan Acad. Sci. 60 B: 202 – 205.

34. Smith, I.M., J. Dunez, R.A. Lelliot, D.H. Phillips, and S.A. Archer, 1988. **European handbook of plant diseases.** Blackwells Scientific Publications, London, 583 pp.

35. Szychowski, J.A., A.C. Goheen, and J.S. Semancik. 1988. Mechanical transmission and rootstock reservoirs as factors in the widespread distribution of viroids in grapevines. Am. J. Enol. Vitic. 39: 213 - - 216.

36. Tanne, E.. 1985. New data on grapevine leafroll disease and its agent. Phytopath. Medit. 24: 88 – 90.

37. Taylor, R.H. and R.C. Woodham. 1972. Grapevine yellow speckle: a newly recongnized graft-transmissible disease of *Vitis*. Aut. J. Agric. Res. 23: 447 – 452.

38. Woodham, R.C. and L.R. Krake. 1983. A comparison of grapevine summer mottle and vein mosaic diseases. Vitis 22: 247– 252.