Status of Grapevine Improvement in California

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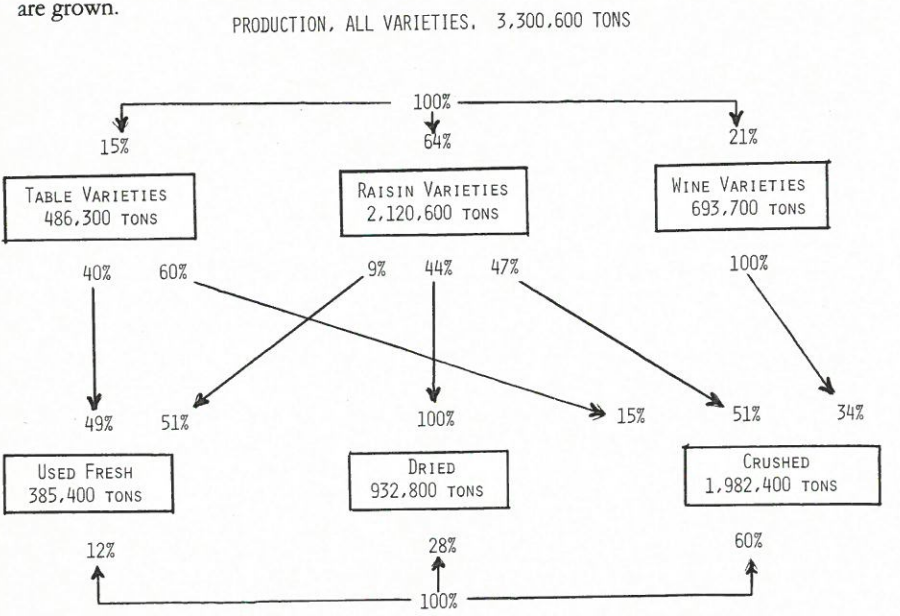
Introduction

California is the only in the United States in which all cultivars of Vitis vinifera are so well adapted. There are about 1,500,000 acres devoted to all fruit crops. About 500,000 acres are devoted to vineyards. We produce approximately 3.000.000 tons of grapes of which 486,000 tons are table varieties, 2.120.000 tons are raisin varieties and 694.000 are wine varieties. Of the table varieties 385.000 tons are used as fresh fruit and the remainder (100.000 tons) are crushed for wine products. Of the raisin varieties 933,000 tons are dried and 1,187,000 tons are crushed. All the fruit from the wine varieties are crushed. In economic value grapes are the number one crop in the State, with a value of approximately $ 225,000,000.

Within the State can be found climatic regions where any variety of vinifera can be successfully grown. There are 6 general geographical regions in which grapevines are grown.

1. North Coast Region in which are grown the premium wine varieties.
2. South Coast Region in which the premium table wine varieties are grown.
3. Sacramento Valley Region in which new plantings are just beginning of above standard table wine varieties.
4. Central Valley Region extending from Sacramento south to about Livingston in Merced County. This is a transitional area where some premium and standard table wine varieties are grown.



5. San Joaquin Valley Region extending from Madera south through Bakersfield. This has been a standard table wine, dessert wine and table and raisin grape area. It is now being planted to above standard table wine varieties. It is the area of greatest expansion in the last three years.
6. Dessert Region in which early maturing table grape varieties are grown.

The premium table wine varieties are grown in the Coastal Regions where low temperatures prevail. In these areas where grapes have been grown in the past, the vineyards are planted on rootstocks resistant to phylloxera. In these same regions where reasonable isolation exists, new vineyards are being planted on their own roots. It is probable that some of these vineyards will have to be replanted on resistant rootstocks. For the most part California is relatively free of soil pests. About 70 % of the vineyards are on their own roots.
The vineyards in Sacramento and San Joaquin Valley are primarily on their own roots. There are areas where phylloxera or nematodes or both exist. These require the use of resistant rootstocks. In the sandy areas nematodes may or may not be present depending upon whether or not it is a new area or one already existing in vineyards.

Within the last three years the sudden increase in vineyard plantings has been in new areas on their own roots. In 1970, approximately 15,000 acres of vines were planted. In 1971, this increased to 30.000 acres, and in 1972 there was an increase to about 40.000 acres. It is expected that in 1973 another 30 to 40 thousend acres will be planted.
The question is often raised why the sudden upsurge in grape acreage. The answer lies in a healthy economic picture of table wine consumption. Since the end of World War II the per capita consumption of wine in the United States has doubled. This means an increase of from 1 to 2 gallons per person, in table and appetizer wines. What was previously an adequate supply of such varieties to produce these table wines has now become a shortage. To offset this shortage, plantings have been made. More optimistic economists like to project an even greater per capita consumption of such wine types so that greater acreages may be needed. Hence the sudden explosion of vineyard plantings in the state. Much of the investments for the past two years have been made by capital not associated with agriculture, but outside interests wanting to get in on a most profitable enterprise since there have been no investment restrictions on vineyards as there have been with some types of orchards.

Registration and Certification

The greater part of the grape planting stock being used today had its origin in 1952 when the California Grape Certification Association, a non-profit corporation, was started. It consisted of leaders of the grape industry both table, raisin and wine, and members of the University of California in the Departments of Viticulture and Enology and Plant Pathology. It was an organization formed to develop and maintain grape stock free from known grape virus diseases and varieties that were true to name. Work began in 1953 with the hiring of a manager, Curtis J. Alley, who under the direction of Professor W. B. Wewitt, Plant Pathologist, started to index the commercially-important rootstocks, wine, table and raisin varieties. Two years later the first planting was made in a foundation vineyard of those varieties that had passed this 2-year indexing test. In 1956, Dr. A. C. Goheen, Plant Pathologist of the U. S. D. A., was stationed at Davis to assume the duties of indexing. Changes to better indicators as well as some of the indexing techniques revealed the presence of virus diseases in some of the foundation vines. At this time the grape certification program, and a similar program for tree fruits, of Prunus species, was combined under the name of Foundation Plant Materials Service (F.P.M.S.).

TABLE 1. INDEXING VIRUS AND VIRUS-LIKE DISEASES OF GRAPEVINES AT DAVIS, CALIFORNIA.

INDICATOR	INDEX METHOD[1]	DISEASE INDEXED	MINIMUM TIME FOR SYMPTOM EXPRESSION
MISSION	CHIP-BUD GRAFT	LEAFROLL	6-18 MONTHS
LN-33	CHIP-BUD GRAFT	CORKY BARK,	6-18 MONTHS
		LEAFROLL	6-18 MONTHS
BACO-BLANC (22A)	CHIP-BUD GRAFT	LEAFROLL	5 MONTHS
		FLAVESCENCE DORÉE	5 MONTHS ?
RUPESTRIS DU LOT	CHIP-BUD GRAFT	FANLEAF (YELLOW MOSAIC, VEINBANDING)	15 DAYS-15 MONTHS
(ST. GEORGE)		ASTEROID MOSAIC	15 DAYS-15 MONTHS
		FLECK	15 DAYS-15 MONTHS
CHENOPODIUM AMARANTICOLOR OR C. QUINOA	MECHANICAL INOCULATION OF PRESSED SAP	YELLOW VEIN (TOMATO RINGSPOT)	5-15 DAYS
		FANLEAF	8-14 DAYS
ANY VINIFERA VARIETY	LEAFHOPPER TRANSMISSION	PIERCE'S DISEASE	2 MONTHS
UNKNOWN		GRAPEVINE YELLOW SPECKLE	

[1] ALL GRAFT-INOCULATION TESTS TO INDICATORS ARE SET IN THE FIELD NURSERY AND HELD 18 MONTHS. ALL MECHANICAL INOCULATION TESTS TO HERBACEOUS INDICATORS ARE MADE IN THE GREENHOUSE AND HELD APPROXIMATELY 30 DAYS.

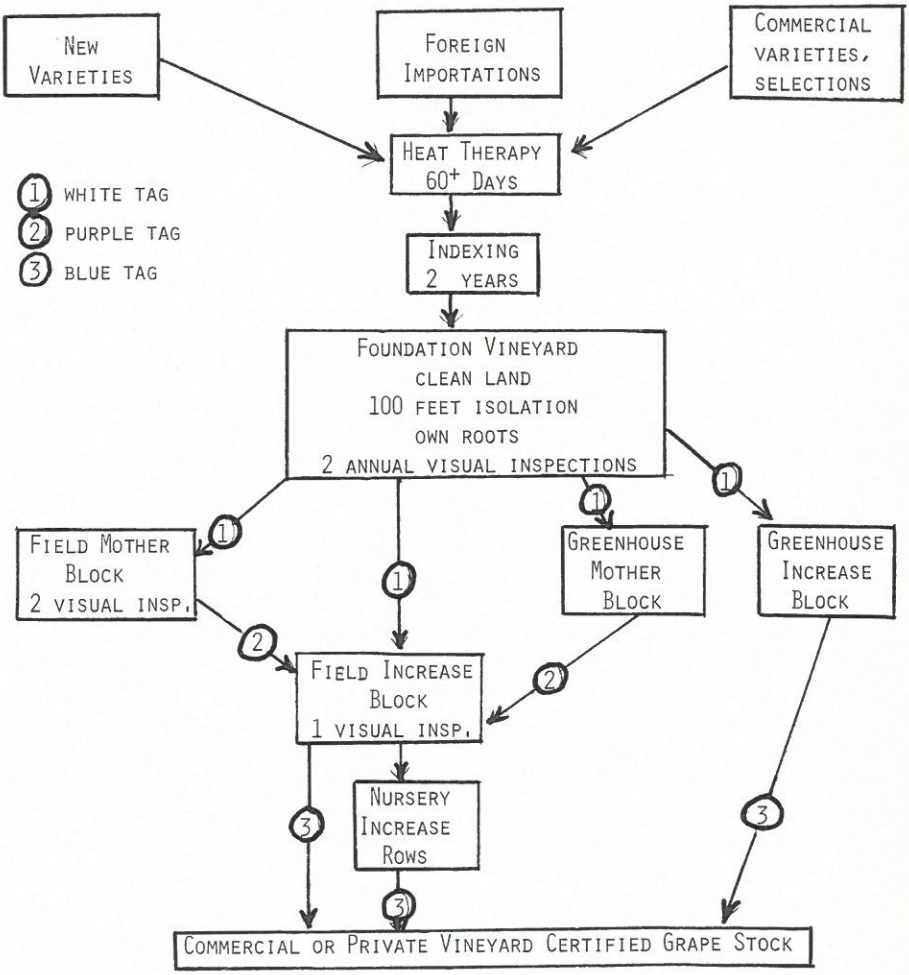
By 1960, the Foundation vineyard was reestablished with many varieties using better and more reliable indexing procedures. Today these same indexing techniques are used. The grape virus diseases that are tested, the indicators used and the time required are shown in Table 1.

Complete indexing requires a minimum of two years. It was not possible to find most varieties (and especially new varieties) in a clean state in commercial vineyards.

In order to develop clean stock from diseased vines, Dr. Goheen constructed heat chambers in which the candidate vines were kept for a minimum of 60 days at a constant temperature of 100^0 F. After the minimum time was reached green shoot tip propagations from the heated vines were made (in a greenhouse) and rooted under intermittent mist and bottom heat. These newly-developed heat-treated vines, after reindexing showed a high percentage to be free from the known virus diseases. Thus the technique was developed to obtain clean stock from diseased vines. Following this achievement, Dr. Goheen then heat-treated every variety and rootstock that was in the Foundation vineyard as a matter of standard procedure and as a precaution in case some of the varieties that were found to be clean initially, may be carrying a latent virus disease for which there were no indexing methods at present and which hopefully could be inactivated through heat therapy. Some of the vines reestablished in the Foundation vineyard have heat treatments as high as 200 days. To date all the important grape varieties and rootstocks presently used in California, and many of the minor ones are planted in the Foundation vineyard.

The procedure used in the present program by Dr. Goheen consists of heat treatment followed by indexing of any grape variety to qualify it for entry into the Registration and Certification program. After completion of indexing, the Pathologist furnishes (to F.P.M.S. for planting in the Foundation vineyard, located at Davis) the initial start which may be one to generally 6 small potted rootings. Propagations from the Foundation vineyard are then distributed first

FIGURE 1. FLOW DIAGRAM OF THE DEVELOPMENT OF CERTIFIED STOCK



to the Mother Block Research Vineyard at Fresno and to nurseries and growers who have field increase block or greenhouse mother blocks. The cuttings and rootings are sold from the field increase blocks and greenhouse increase blocks to commercial and private growers as certified stock. A flow diagram of this entire procedure is shown in Figure 1.

When this program first started, until 1953 it was completely subsidized by a grant from industry and the University. In 1958, it realized some income from the sale of stock. By 1968, economic conditions at the University were becoming more severe and F.P.M.S. had to become self supporting by the sales of plant materials.

The F.P.M.S. commitee which sets policy for the operation of F.P.M.S. has been instrumental in determining procedure by which the organization would become completely self supporting and realizing that as more wood became available from increase blocks the demand for Foundation stock would decrease. Since Foundation stock costs more than certified stock, measures were taken to insure adequate future income through the use of royalty fees. Heat-treated stocks were just becoming available. All nurserymen and growers having a greenhouse increase or field increase block in order to sell certified stock had to sign a "growers agreement". This provides for the payment of a royalty for any certified stock sold, used or given away. The fee has been set at $. 02 per unit for non heat-treated and $. 05 per unit for heat-treated stock. This method is providing adequate support for the program. This year the royalty fee for heat-treated stock was reduced to $. 02 per unit.

Private growers and breeders having new varieties which they want tested or heat-treated may obtain this service through F.P.M.S. charges are made for this service. This year Dr. Olmo is releasing a new wine variety adapted for the hot climates. This is the first time the University has patented a fruit variety. The income from royalty fees will be used partly for University needs and partly for viticultural research.

Once adequate supplies of certified stock are available it is very possible that a quarantine may be placed on the use of non certified grape materials. Presently grape materials cannot be imported into California unless they are indexed. Such imported stocks are held (in quarantine) by the Pathologist until they have been indexed and found to be free from known grape virus diseases.

Rapid Propagation of Own Rooted Vines

Until about 1969 the Registration and Certification program was moving along in a relatively slow manner and vineyard increase blocks were being established. Suddenly about that time the vineyard planting spree began with a stepped up planting of new vineyards to fill the short supply that was occuring in the table wines, appetizer wines and sparkling wines. New plantings and very large plantings of 1.00 to 1,200 acres became frequent. Most of these large plantings and very large plantings of 1,000 to 1,200 acres became frequent. Most of these large plantings occurred in the San Joaquin Valley. The certification program was not geared to this sudden increase although everyone wanted certified stock since it had been shown earlier to be superior to the existing non certified stocks. As a result, two things occured. The more impatient and less knowledgeable growers and developers were using non certified field run materials. Better enlightened growers and developers were demanding the clean stock from the certification program, but in quantities far greater than what was available by present ordinary methods. A way had to be found to rapidly-propagate the limited quantities of certified materials. The experience that Dr. Goheen had found in his heat treatment and subsequent propagation was put to use by commercial nurserymen that had large greenhouses and were propagating ornamentals. The Oki Nursery in Sacramento was the first to employ this technique. They started in February with dormant cuttings which were cut into one-bud cuttings. First they were planted in beds in a mixture of perlite, peat moss and sand. Temperatures were maintained at 75 – 80^0 F. About 4 weeks were required for these dormant one-bud cuttings to root and start growing. Then they were transferred to one gallon cans for use as mother plants. When the shoots attained a heigh of 12 – 16 inches, the vines were cut back to 2 – 4 buds. Each green shoot was then cut into one-bud cuttings having the bud with its subtending green leaf at the top of the cutting. The base of the shoots were given a quick dip using concentrated indole butyric acid and the cuttings were placed in beds of perlite-peat mix under

intermittent mist. If the temperature was maintained at 80 - 85^0 F the cuttings required 10 - 12 days to root. Those that rooted were transferred into 3" x 3" x 3" plastic pots. The vines remained in these pots and were delivered to the grower in this manner. From the time the vines were transferred into the plastic pots, three to four weeks were required for them to reach a height of 12" - 16". If the season was too early for delivery, these potted plants were cut back for use as further propagating stock. Just prior to delivery, the vines were moved to a lath house or the greenhouse was opened and cooled down to allow the vines to harden for about a week. All during the growing period the vines were watered by intermittent mist. The vines were fertilized thru the mist system.

Supplies of Foundation stock are very limited. Greenhouse propagators would obtain perhaps 200 cuttings of a variety. In addition to the standard cuttings, small cuttings and even brush is used. Greenhouse growers prefer the small sizes and brush to the no. 1 cuttings as it roots and grows more uniformly under greenhouse conditions.

As an example of the rapidity of this method of propagation, if one could start with all the dormant wood from two 4 year old vines of a premium wine variety he would get approximately 1,000 - 1,200 one bud dormant cuttings. By the end of the propagation season in July and by cutting up all the green shoots as soon as they reached the 12" - 16" height into one bud green cuttings, a greenhouse grower could theoretically propagate in excess of 500,000 plants. A year after the Oki Nursery started this rapid propagation, three other greenhouse growers began. Presently there are about ten such growers.

Modified Bench Grafting Techniques

Rapid propagation techniques have been developed to handle the sudden demand for planting stock on its own roots. Such techniques are not available for vines grafted on resistant rootstocks. Even since the beginning of the certification program clean rootstocks have been in short supply before the sudden upsurge for planting stock. The several standard procedures that have been followed by growers are as follows:

1. A grower could contract with three or possibly four nurserymen in the North Coast area doing custom benchgrafting for their needed benchgrafts. The supplies of rootstocks and top stocks are limited. Nurserymen have been using the standard machine benchgrafting techniques and growing the vines in the nursery for one year. The use of AxR no. 1 for benchgrafting was discouraged because this rootstock callused very poorly and nursery takes were very poor. So nurserymen preferred to benchgraft only St. George.

2. Nurserymen would plant disbudded rootstock cuttings of AxRno.1 and St. George in the nursery. At the end of the year he sold rootings of the resistant rootstocks. It was the job of the grower to plant the rootings and in late August or September bud the vines if they made satisfactory growth. When budwood was not available in September because of short supply, immature wood, or the rootstocks were too small, the growers collected wood during the winter, placed it in refrigeration and budded their vines in June and July. This practice is used in some of the North Coast counties.

3. Nurserymen in the San Joaquin Valley generally do not benchgraft. They plant nematode-resistant rootstock cuttings of 1613, Dog Ridge, Salt Creek and Harmony in the nursery and grow them for one year. In the following spring, the grower plants the rootings in the vineyard and allows them to grow for the year. In the following spring, the vines are field grafted to the desired variety. This practice is more common than field budding.

Of the resistant rootstocks the shortest in supply has been AxR no. 1 and Saint George for the coastals regions. The quickest method has been the modified benchgrafting technique recently introduced by Dr. John Weinberger, U.S.D.A. Field Station at Fresno. Essentially he uses the same benchgrafting methods as used by nurserymen in Europe and California as far as machines are concerned. After the benchgrafts are callused, the scion and graft union to about an inch below are dipped in paraffin wax. Then they are planted into heavy paper or plastic-paper cylinders or tubes and placed in a warm greenhouse. Under these warm temperatures of $75^0 - 85^0$ F the benchgrafts grow rapidly. When the shoots reach 10" - 14" the benchgrafts are hardened before planting in the vineyard. Only the good benchgrafts are delivered to the grower. The poor or weak benchgrafts are held in the greenhouse until they reach the acceptable size for delivery. So the grower starts with 100 % growing vines. Since these young benchgrafts are planted as growing vines they must be handled very carefully and watered immediately and frequently for the first two-three month. The field care ist much greater and mor expensiv for handling these benchgrafts than the standard method of planting dorment benchgrafted rootings.

By this modified benchgrafting method, nurseries are able to stretch their supply of rootstock material. Instead of using a rootstock cutting 10" - 12" long they may cut down the length to 6" - 8". The rootstock cutting is not planted deeply in 7" - 8" paper cylinder so that roots can fill the volume of the soil mix.

The most critical time when following this technique is just after the callused benchgrafted cuttings are removed from the callusing boxes or bins dipped in paraffin planted in cylinders and placed in the greenhouse. Direct sun on the callused grafts is very detrimental. It is strongly recommended that the grafts be shaded for the first week to ten days until the buds push. Humidity should be high.

The use of the greenhouse technique has resulted in a high take when using AxR no. 1 rootstock than when the standard technique was used. A rapid benchgrafting technique similar to the rapid propagation technique used for own rooted vines is yet to be developed.

Rootstock Improvement

Phylloxera was introduced into California in late 1850 in the coastal regions where the soil was heavy and had a tendency to crack upon drying out. Since most vineyards were non irrigated this pest has managed to remain in place. Because California has a dry climate in the summer and low relative humidity, the pest does not develop the winged form. All multiplication and movement must occur through the ground. Hence the spread of phylloxera has not been rapid as under European conditions.

V. rupestris St. George has been the most successful rootstock in California for non irrigated vineyards, on hillsides, and on rocky thin soils. Because of profuse formation of callus and easy rooting ability, it is prefered for benchgrafting. The work of H. E. Jacob indicated that AxR no. 1 was superior in production even though it has less vigor than St. George in deep fertile soils. AxR no. 1 is recommended for irrigated vineyards or deep fertile soils. Very little of no benchgrafting (old method) is practiced with this stock because it calluses so poorly. Most vineyardists purchase the rootings and chip bud in the Fall or early summer.

The prominent SO-4 rootstock is now being evaluted in California. In California under non irrigation its performance has been poor, however, in irrigated vineyards it appears promising. California does not have high lime conditions, so the advantage of this stock cannot be utilized. In addition yo the above mentioned stocks, Professor Lider is also testing Teleki 5A and Kober 5BB.

In the South Joaquin Valley, most of the soils are sandy. Nematodes are the problem as phylloxera cannot survive under the sandy soils and frequent irrigation methods employed. The full nematode picture is only in its beginning. Whereas growers thought only of the root knot nematode Melodogyne incognita var acrita, there are now recognized several other ectoparasitic types as the root lesion nematode Pratylenchus vulnus and the even more important Dagger nematode Melodogyne incognita var. acrita and Melodogyne Javanica there are now recognized several other extoparasitic types as the root lesion nematode Pratylenchus vulnus and the even more important Dagger nematode Xiphinema indes. The rootstock presently used in infested areas is 1613 (V. solonis x Othello). This is resistant to the root knot nematodes and moderately resistant to Xiphinema index, with little or no resistance to the lesion nematode Pratylenchus vulnus or phylloxera.
A recent introduction is the Harmony rootstock which is reported to have resistance to the root knot nematode and moderate phylloxera resistance. Prof. Lider has been working on rootstocks having resistance to both nematodes and phylloxera. For this combination resistance his hybrids of champini-rupestris and champini-riparia have been most encouraging. With the recognition of Xiphinema index as a serious pest, work has been underway the past few years to breed for vines resistant to it. The work of Kunde (Graduate Student under Lider) has shown that a few species have good resistance to this nematode. The development of such resistant rootstocks are in the future. In the meantime, only the present champini stocks are being used in the South San Joaquin Valley particularly in very sandy areas. These stocks planted in fertile soils produce an excessive vigor problem which presently management cannot overcome. Research is in progress using deeply placed fumigants and replanting with own roots.

Zusammenfassung

„Über den Stand der Pflanzguterzeugung in Kalifornien"

Kalifornien ist der einzige Staat in den USA, wo alle Europäerrebsorten angebaut werden können. Die Gesamtfläche des Obstbaues beträgt 600.000 ha, davon 200.000 ha Weinbergsanlagen mit einem wirtschaftlichen Wert von 225 Mill. $. Die Traubenproduktion beläuft sich auf 3 Mill. t, wovon 486.000 t auf Tafeltraubensorten, 2.120.000 t auf Rosinensorten und 694.000 t auf Weintraubensorten entfallen. Von den Tafeltrauben werden 40 % frisch verbraucht und 60 % zu Wein verarbeitet. Auch von den Rosinensorten gelangen noch 47 % in den Wein. Innerhalb Kaliforniens unterscheidet man 6 geographische Hauptzonen in denen Reben angebaut werden, die nördliche Küstenregion mit frühen Qualitätsweinrebsorten u. a. Pinot noir, Chardonnay und Weißer Riesling, die südliche Küstenregion mit frühen Tafelweinsorten, die Region des Sacramento Valley, die Zentraltal-Region, das St. Joachim-Tal mit Sorten für Tafel- und Dessertweine sowie solchen für die Rosinenherstellung und die Dessertwein-Region in welcher frühreifende Tafeltrauben erzeugt werden. Etwa 70 % der Weinberge sind noch wurzelecht, dort wo die Reblaus oder Nematoden vorhanden sind, werden reblausresistente Unterlagen verwendet. Die Zahl der Neuanlagen von Weinbergen ist ständig im Steigen begriffen, sie betrug 1972 16.000 ha und wird veranlaßt durch den wachsenden Konsum von Tafelweinen und Aperitivs, der sich seit dem 2. Weltkrieg verdoppelt hat, und z. Zt. etwa jährlich 7,6 l pro Kopf beträgt.

Im Jahre 1953 nach Gründung der California Grape Certification Association, begann man mit der Untersuchung der Rebenbestände auf die damals bekannten Viruskrankheiten in die auch die Weintrauben-, Tafeltrauben- und Rosinensorten einbezogen wurden. Mit dem virusfreien

Material errichtete man Basisvermehrungsanlagen. Die 1-jährige Untersuchung erfolgt mit Hilfe der Indexing-Indikatoren Mission, LN 33, Baco 22 a, Rupestris du Lot oder der Impfung auf Chenopodium amaranticolor bzw. Ch. quinoa zur Prüfung auf die Viruskrankheiten Leafroll, Corky bark, Flavescence dorée, Yellow Mosaic, Asteroid Mosaik Fleck, Tomato ringspot und Pierce's disease. Da es bei den meisten Sorten nicht möglich war, völlig virusfreies Material in den Weinbergsanlagen zu finden, mußte dieses erst mittels der Thermotherapie bei 37,8^0 C in einem Gewächshaus (mind. 60 Tage lang) angezogen und als Grünstecklinge in Sprühnebelkultur vermehrt werden. Nach durchlaufener Hitzebehandlung und erneutem Indexing werden die Sorten registriert, zertifiziert und in das Vermehrungsverfahren aufgenommen. Die Versorgung mit hitzebehandelten Rebsorten erfolgt über den Foundation Plant Materials Service (F.P.M.S.) gegen eine Gebühr. Mit den Pflanzguterzeugern wird ein entsprechender Vertrag abgeschlossen. Auch private Züchter können ihre neuen Sorten durch diese Organisation testen lassen. Die Einfuhr von Reben nach Californien ist z. Zt. nur nach einer Quarantänezeit möglich während der das Material auf Virusfreiheit getestet wird.
Um die Versorgung mit getestetem zertifiziertem Pflanzgut möglichst schnell vornehmen zu können, wurde eine neue Vermehrungstechnik entwickelt, die darin besteht, daß Einaugenstecklinge innerhalb 4 Wochen in einem Substrat von Perlite, Torf und Sand bei einer Temperatur von ca. 24 - 26^0 C bewurzelt werden. Der Austrieb der so erhaltenen Mutterpflanzen wird dann weiter zu Einaugen-Grünstecklingen verarbeitet, deren Basis kurz mit dem Wirkstoff Indolbuttersäure behandelt und in dem genannten Substrat unter Sprühnebelatmosphäre bei ca. 26 - 29^0 C in 10 - 12 Tagen bewurzelt wird. Nach weiteren 3 - 4 Wochen können die in Plastiktöpfen gepflanzten Reben nach Abhärtung verkauft werden. Durch diese Methode kann eine sehr schnelle Vermehrung erreicht werden, so daß von dem Holz eines 4-jährigen Rebstockes, der normal 1.000 - 1.200 Einaugenstecklinge abwirft, im Extrem bis zu 500.000 Jungpflanzen erzielt werden können.

Als Veredlungsmethode wird entweder die Tischveredlung mit der Maschine unter Verwendung der Unterlagssorte Rupestris St. George und anschließende Rebschulkultur benützt oder es werden Standortveredlungen durchgeführt. Die Rebschulisten pflanzen zu diesem Zweck Unterlagenstecklinge der Sorten Aramon x Rupestris Nr. 1 oder Rupestris St. George in ihre Rebschulen und okulieren sie entweder im August oder September mit frischen Augen oder im Juni/Juli mit im vorangegangenen Winter geschnittenem und bis zur Verwendung kühlgelagertem Edelreismaterial. Im St. Joachim-Tal werden keine Tischveredlungen hergestellt sondern in der Regel nematoden-resistente Unterlagenstecklinge der Sorten 1613, Dog Ridge, Salt Creek und Harmony in der Rebschule bewurzelt, im nächsten Jahr in den Weinberg gepflanzt und nach 1 Jahr im folgenden Frühjahr am Standort veredelt.

Die schnellste Vermehrung wurde mittels der modifizierten Tischveredlung v. J. Weinberger erzielt, ähnlich der die auch in Europa angewendet wird. Nach der Kallusbildung wird das Edelreis bis unter die Veredlung in Paraffin getaucht, in Zylinder bzw. Röhren von kräftigem Papier oder Plastikpapier eingepflanzt, im warmen Gewächshaus weiter kultiviert und nach Abhärtung die besten Pfropfreben direkt in den Weinberg gepflanzt. Mit der Methode können kürzere Unterlagen von 15 - 20 cm Länge benützt werden, die Anzucht und Pflanzung verlangt viel Sorgfalt und in den ersten 3 Monaten eine reichliche Wasserversorgung.
In den reblausverseuchten Gebieten Kaliforniens hat sich die Unterlagssorte V. rupestris St. George, insbesondere für die trockenen und felsigen Böden, am besten bewährt. Wegen ihrer reichlichen Kallusbildung und guter Bewurzelungsfähigkeit benutzt man sie für die Tischveredlung bevorzugt. Bewässerte Weinberge oder tiefgründige Böden werden mit Aram x Rup. 1 Gz bepflanzt, sie wird meist im Herbst oder Frühsommer als bewurzelter Steckling okuliert. Die Unterlagssorten SO4, 5A und Kober 5BB stehen in Kalifornien z.Zt. in Prüfung. In Sand-

böden, in welchen die Reblaus nicht überleben kann, erwachsen Probleme durch die dort gefundenen Nematoden Melodogyne incognita var. acrita, Melodogyne javanica, Patrylenchus vulnus und Xiphinema index. Die Unterlagssorte 1613 (Solonis x Othello) ist resistent gegen die Wurzelknoten-Nematoden und besitzt eine mäßige Resistenz gegen Xiphinema index. Durch die Arbeiten von Prof. Lider wird eine Resistenz sowohl gegen die Reblaus als auch gegen Nematoden angestrebt. In der Richtung auf dieses Zuchtziel wurden aussichtsreiche Kreuzungsprodukte zwischen V. Champini x V. rupestris und V. champini x V. riparia gewonnen.

Résumé

La production des plants de vigne en Californie

La Californie est le seul état des Etats-Unis où tous les cépages d'Europe peuvent être cultivés. La superficie totale des cultures fruitières atteint 600 000 ha, dont 200 000 ha de vignobles donnant un produit de 225 millions de dollars. La production de raisin se situe à 3 millions de tonnes, dont 486 000 tonnes de raisins de table, 2 120 000 tonnes de raisins à sécher et 694 000 tonnes de raisins de cuve. Parmi les raisins de table, 40 % sont consommés à l'état frais et 60 % sont vinifiés. En ce qui concerne les raisins à sécher, 47 % sont également employés pour la vinification.

On distingue en Californie 6 zones géographiques où la vigne est cultivée : la région côtière du nord avec des cépages de qualité précoces tels que Pinot noir, Chardonnay et Riesling, la région côtière du sud avec des variétés de table précoces, la région de la vallée de Sacramento, la région de la vallée centrale, la vallée de St. Joachim avec des cépages pour vins de table et de dessert ainsi que des cépages pour la production des raisins secs, et la région des vins de dessert dans laquelle sont cultivés des raisins de table précoces. Environ 70 % des vignobles ont encore francs de pied ; là où le phylloxéra ou les nématodes existent, on utilise des porte-greffe résistants. Le nombre des nouvelles plantations de vigne s'accroît constamment ; elles atteignaient 16 000 ha en 1972 et sont conditionnées par la consommation croissante de vins de table et d'apéritifs, qui a doublé depuis la 2e guerre mondiale et atteint actuellement 7,6 l par tête.

En 1953, après la fondation de l'assiciation californienne pour la certification des plants de vigne, on a commencé de rechercher les parcelles de raisins de cuve, de table ou à sécher, dans lesquelles les maladies à virus connues alors avaient pu être introduites. Avec le matériel exempt de virus, on a établi des parcelles de base. L'examen, étalé sur 2 ans, s'effectue à l'aide des vignes indicatrices Mission, LN 33, Baco 22 A, Rupestris du Lot, ou bien par l'infection de Chenopodium amaranticolor ou Chenopodium quinoa, afin de rechercher les viroses de l'enroulement, du corky bark, de la flavescence dorée, de la mosaîque jaune, de l'asteroid mosaik fleck, du tomato rings-pot et de la maladie de Pearce. Comme il n'etait pas possible, pour la plupart des variétés, de trouver au vignoble des matériels totalement exempts de virus, on a dû d'abord obtenir de tels matériels par la thermothérapie à 37,8^{o} C en serre (pendant au moins 60 jours) et les multiplier ensuite en vert en culture sous nébulisation. Après une thermothérapie répétée et de nouvelles indexations, les variétés ont été enregistrées, certifiées et mises en multiplication.

L'approvisionnement en matériels traités par thermothérapie s'effecture contre redevance par les soins du «Fondation plant materials service» (F.P.M.S.). Des contrats sont conclus avec les pépiniéristes. Les obteneurs privés peuvent également faire tester leurs nouvelles variétés

par cette organisation. L'introduction de plants de vigne en Californie n'est actuellement possible qu'après une quarantaine, pendant laquelle les matériels sont testés à l'égard des virus.

Afin de pouvoir réaliser un approvisionnement aussi rapide que possible en matériels certifiés et testés, on a mis au point une nouvelle technique de multiplication qui consiste à faire enraciner des boutures à un œil en 4 semaines dans un substrat de perlite, tourbe et sable à 24-26^0 C. Les pousses des plantes ainsi obtenus sont débitées ensuite en boutures vertes à un œil, dont la base est traitée à l'acide indolbutyrique et qui sont à leur tour mises à enracier sur le même substrat à 26–29^0 C pendant 10–12 jours, 3 ou 4 semaines plus tard, les plants placés en pots de plastique peuvent être vendus après leur durcissement.

Cette méthode permet une multiplication très rapide, de sorte qu'à partir du bois d'une souche de 4 ans, qui normalement donnerait 1 000 à 1 200 boutures à un œil, on peut, à l'extrême, obtenir jusqu'à 500 000 jeunes plants.

Pour le greffage, on utilise soit le greffage sur table à la machine en utilisant le porte-greffe Rupestris St-George, puis la culture en pépinières, ou bien on pratique le greffage sur place. A cet effet, les pépiniéristes plantent des boutures d'Aramon x Rupestris n° 1 ou de Rupestris St-George dans leurs pépinières et les greffent soit en août ou septembre avec des greffons à un œil en vert, soit en juin-juillet avec des greffons taillés au cours de l'hiver précédent et conservés en chambres frigorifiques jusqu'à leur utilisation. Dans la vallée de Saint-Joachim, on ne pratique pas la greffe sur table, mais on fait raciner en pépinières des boutures des porte-greffes résistant aux nématodes des variétés 1613, Dog Ridge, Salt Creek et Harmony, qui sont plantées au vignoble l'année suivante et greffées sur place un an plus tard.

La multiplication la plus rapide a été obtenue au moyen du greffage sur table modifié par J. Weinberger, semblable à celui utilisé en Europe. Après la formation du cal, le greffon est trempé dans la paraffine jusque sous la soudure; la greffes-bouture est plantée dans des tubes de papier fort ou de papier plastifié et cultivé en serre; après durcissement, les meilleurs greffés-soudés sont plantés directement au vignoble. Cette méthode permet l'utilisation de porte-greffes plus courts (15 à 20 cm); la culture et la plantation demandent beaucoup de soins et il faut arroser copieusement pendant les trois premiers mois.

Dans les régions phylloxérées de Californie, c'est le porte-greffe Rupestris St-George - Rupestris du Lot qui s'est avéré le meilleur, particulièrement pour les sols secs et caillouteux. Grâce à sa formation abondante de cal et sa bonne aptitude à l'enracinement, on utilise de préférence le greffage sur table. Dans les vignobles irrigués et les sols profonds, on plante l'Aramon x Rupestris Ganzin n° 1, qui est généralement greffé sur place en automne ou au printemps. Les porte-greffe SO 4, 5 A et Kober 5 BB sont actuellement à l'essai en Californie. Dans les sables, où le phylloxéra ne vit pas, se posent des problèmes à propos des nématodes qu'on a trouvés: Melodogyne incognita, Melodogyne javanica, Pratylenchus vulnus et Xiphinema index. Le porte-greffe 1613 (Soloni x Othello) est résiaux nématodes des racines et possède une résistance moyenne à l'egard de Xiphinima index. Les travaux du Prof. Lider s'efforcent de trouver des porte-greffes résistants à la fois au phylloxéra et aux nématodes. Dans cette voie, on a trouvé des croisements intéressants V. Champini x V. Rupestris et V. Champini x Riparia.