PRUNING AND TRAINING GRAPEVINES

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PRUNING

The primary functions of pruning grapevines are to--

- Shape the vine and maintain this shape so cultural practices can be carried out economically. (For example, cultivation, irrigation, disease and pest control, and harvesting.)

- Regulate crop. Pruning is the cheapest way to reduce the number of clusters and prevent overbearing of the vine. Thinning is a more efficient way to regulate crop but too costly.

- Distribute the bearing wood over the vine and regulate the amount of bearing wood according to each individual vine's capacity. Proper pruning results in a good crop of quality fruit year after year.

TRAINING METHODS COMMONLY USED IN SAN JOAQUIN COUNTY

Head System

Vine is given the shape of a small upright shrub. Has a vertical trunk 1 to 3 feet high which supports a ring of arms at its head. At the end of these arms, at each winter pruning, are left the spurs to produce the shoots that will bear the next crop and furnish canes for the following year's spurs. Thus, this system consists of head training and spur pruning.

Advantages of head system

- Simplicity of form (shape).
- Easy to train.
- Cheap to establish.
- No wire trellis needed.
- Short stakes are required for about 10 years until trunks are rigid enough to be self-supporting.
- Cross-cultivation is possible--help in the control of noxious weeds.

Disadvantages of head system

- Requires severe pruning which depresses the growth of the vine.
- Slow to come into full production.
- Masses the fruit within a small area, which can cause bunch rot, poorer color on some varieties.

Head training is used on varieties that bear well on short spurs. (Example: wine grapes, Tokays)

Cordon System

Vines of this system have no definite head. The bilateral horizontal cordon has a trunk which rises vertically to a point about 8 inches below the lower wire of the trellis. At this point it is divided into two branches and extends in opposite directions along the lower wire to within about 6 inches of the adjacent vines on either side.

The bends should be smooth and regular, the branches should be straight. Don't retain shoots or spurs at the bend of mature vines--they will become very vigorous, thus shading out the other spurs.

The bearing units are spurs off of small arms located at regular intervals on the horizontal branches (cordons). Spurs should be located on the upper side of the cordons.

Advantages of cordon system

Cultural

- Pruning - All spurs same height.
- Thinning - Fruit easily reached.
- Harvesting - Easier by hand. Can be harvested by present mechanical harvesters.
- Irrigation - Ditches easily put in and closed because of space between rows.
- Weed Control - Center of rows can be cultivated without destroying the vines.

Quality

- Less sunburn damage.
- Less rot. Fruit better distributed.
- Good light and air exposure result in better color.

Production

- Good production during early years of the vine.
- Larger production over year due to better light intensity for bud development.

Disadvantages of cordon system

- More costly to establish.
- Requires more skill and work to establish.
- Requires a trellis system.

Cordon training is used on most of the table grapes and large clustered wine varieties in California.

Cane-Pruned System

The form of the vine is similar to that of head-trained vines except the head is fan-shaped in the plain of the trellis. Only two arms on each side of the head are usually needed. At each annual pruning fruit canes, 8 to 15 buds (2 to 5 feet long) are retained for producing the crop. Old fruit canes are removed each year. Canes for use the following year are produced from the renewal spurs, which are located on the arms near the head of the vine.

Advantages of cane-pruned system

- Obtain full crop on varieties that have sterile buds near the base of the cane. (Example: Thompson Seedless)
- Produce better crop on very small clustered wine varieties. (Example: Cabernet Sauvignon, White Riesling, Sauvignon blanc)
- Spread fruit out, if thinning is done.

Disadvantages of cane-pruned system

- Tendency of most varieties to overbear, resulting in poor quality fruit.
- Higher cost of pruning and training canes.
- Trellis system needed.
- Careful selection of quality canes at pruning is a must.

Regulate Crop by Pruning

Crop level influences the quality of fruit at harvest time. If excessive bearing wood is retained at pruning time, an overcropped situation occurs. Vines have the capacity to produce only so much fruit and bring it to normal maturity. To increase crop beyond this will result in delay of maturity, poor fruit color, reduce vine growth, cause irregular production from year to year, and poor balance of sugar and acid in the fruit.

See tables on the next page.

RELATION OF LEVEL OF CROP TO TIME OF MATURING AND ACID CONTENT

Variety	Crop in Tons	Date of Harvest	° Balling	% Acidity
Mission	7	9-22	23.5	.62
	9	9-30	23.0	.57
	10	10-7	23.0	.35
Zinfandel	6	9-9	21.5	1.13
	8	9-28	22.2	.83
	10	10-12	21.7	.71

THE EFFECT OF LEVEL OF CROP ON COLOR DEVELOPMENT

Crop	Clusters to a Vine		Percent Colored	
	Tokay	Emperor	Tokay	Emperor
Light	24		71	
Normal	32	25	65	94
Medium heavy	44	35	59	71
Very heavy	60	40	51	64

For detailed information on pruning, refer to Cir. #477, "Pruning Grapevines," by A. J. Winkler; textbook General Viticulture by A. J. Winkler.

TRAINING GRAPEVINES

In the development of young vines, the grower must know the shape (form) required for the mature vine. The actual training follows a definite procedure. Pruning and disbudding are done to direct the growth into the parts of the vine to be retained. Tying to the stakes and trellis is done to maintain the vine in the desired position.

First Summer

The object during the first year is to develop a good root system. No training is done the first growing season.

At the end of the first growing season the vine should have a well established root system and a well matured top growth.

TRAINING HEAD-TRAINED VINES

Second Year

Follow the steps as shown on the attached diagrams.

Diag. I, Step a. Prune the tops back to two or three well formed buds positioned next to the stake (own-rooted vines).

Diag. IV, Steps A, B. This is the procedure for resistant rootstocks that were fall-budded the first year. When the tips of the rootstock begin to grow and the scion buds are swelling, then cut the resistant rootstock off 1 inch above the scion bud. Slant the cut away from the bud so that the vine does not bleed directly onto the bud. Place a paper sleeve around the vine to protect the new shoot that will develop.

Diag. I, Step b. Disbud or rub off all the new shoots that began to grow except for one strong shoot that is positioned for growing vertically up the stake.

Diag. I, Step c. Tie the shoot when it is 8 to 12 inches long. Retie it two or more times as the shoot grows up the stake. Top the main shoot after it has grown 12 to 16 inches above the height you want to establish your head. Topping will encourage the growth of the side laterals.

Third Year

Diag. II, Step d. (Winter) Dormant pruning consists of removing all the growth from the cane trained up (the future trunk). However, if the vines are excessively strong, retain 3 to 4 top laterals and prune them back to one or two buds. These will act as fruiting spurs and will help to develop the head rapidly. Remove all laterals on the lower portion of the trunk where no permanent arms are desired. The cane should be cut off at the first node above the level where the head is desired. Make this cut through the node in a way it will destroy the bud but retain an enlarged

knob which facilitates tying. Use a clove hitch around the top of the cane and tie securely to the stake using a square knot. Make two or three more loose ties to hold the vine to the stake.

Diag. II, Step e. (Spring) Break out the lower shoots and disbud the lower portion of the trunk. Retain all the upper laterals for future head development.

Diag. II, Step f. (Summer) Remove suckers and clean up lower portion of the trunk by breaking out unwanted shoots. The first crop of 2 to 4 tons will be born.

Fourth Year

Diag. III, Step g. Dormant pruning consists of leaving 4 or 5 well placed spurs. Continue to sucker and remove unwanted shoots during the spring and summer.

You have now developed the framework for a mature vine.

TRAINING BILATERAL CORDON VINES

Follow steps as shown on attached diagrams.

First Summer

Use same procedure as described under Head-Training.

Second Year

Diag. I, Step a. See Head-Training.

Diag. IV, Steps A,B. See Head-Training.

Diag. IV, Step C. Tie shoots when they are 8 to 12 inches long. Retie two more times as the shoot grows up the stake. Don't place any ties above the cordon wire.

After the main shoot has grown 12 to 18 inches above the cordon wire, top it at the cordon wire.

Diag. V, Step D. Select two strong laterals placed 6 to 12 inches below cordon wire. Let these laterals grow upward until they are 18 to 24 inches long. Remove all other laterals on the lower portion of the trunk.

Diag. V, Step E. Tie these 24-inch laterals to the cordon wire, one in each direction. As they continue to grow, keep them straight by tying them loosely to the cordon wire. DO NOT tie the portion of the shoot that is elongating a foot or more from the tip.

Pinch the ends of these laterals after they have grown about 18 inches beyond the halfway point to the next vine.

Third Year

Diag. VI, Step F. (Winter) Dormant pruning consists of cutting off all the lateral growth from the cordon branches. If vines are very vigorous you can leave spurs on the cordon branches. Space these spurs 6 to 8 inches apart. Be sure these spurs are on the top side of the cordon. The length of the cordon depends on the previous year's growth. Strong cordons can be left to about the halfway point between vines, providing summer shoot removal is carried out to control crop the next spring (Diag. VI, G). If no summer shoot removal is planned, then cut the cordons back to 2 or 2½ feet to keep from overcropping the vines the next year.

Tie the new cordons onto the wire.

Diag. VI, Step G. (Spring) Remove all shoots from the bends of the cordons. Remove all shoots and disbud the lower trunk area. If long cordons are retained, remove all the shoots on the bottom of the cordons. Space out the upper shoots at about 6 inches apart by removing unwanted shoots.

Fourth Year

Diag. VII, Step H. (Winter) Retain 4 to 5 two- or three-bud spurs on each side of the cordon. Remove all other growth. Be sure spurs are placed on the upper part of the cordon (if possible).

Spring Continue to remove shoots from the bends of the cordons and from the trunk.

Note: Amount of bearing wood retained varies as to variety.

HEAD TRAINING

Second Year

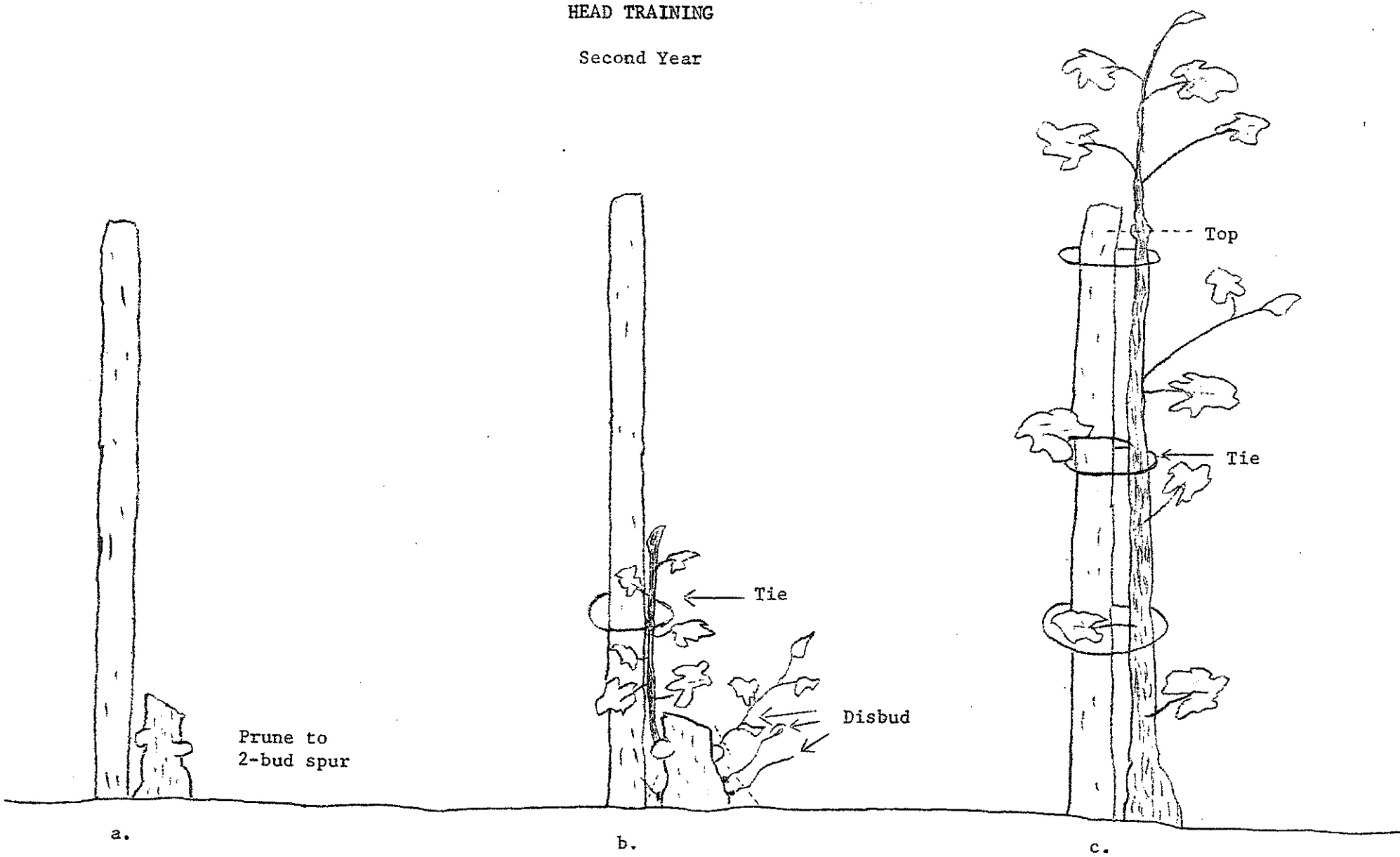


DIAGRAM I

HEAD TRAINING

Third Year

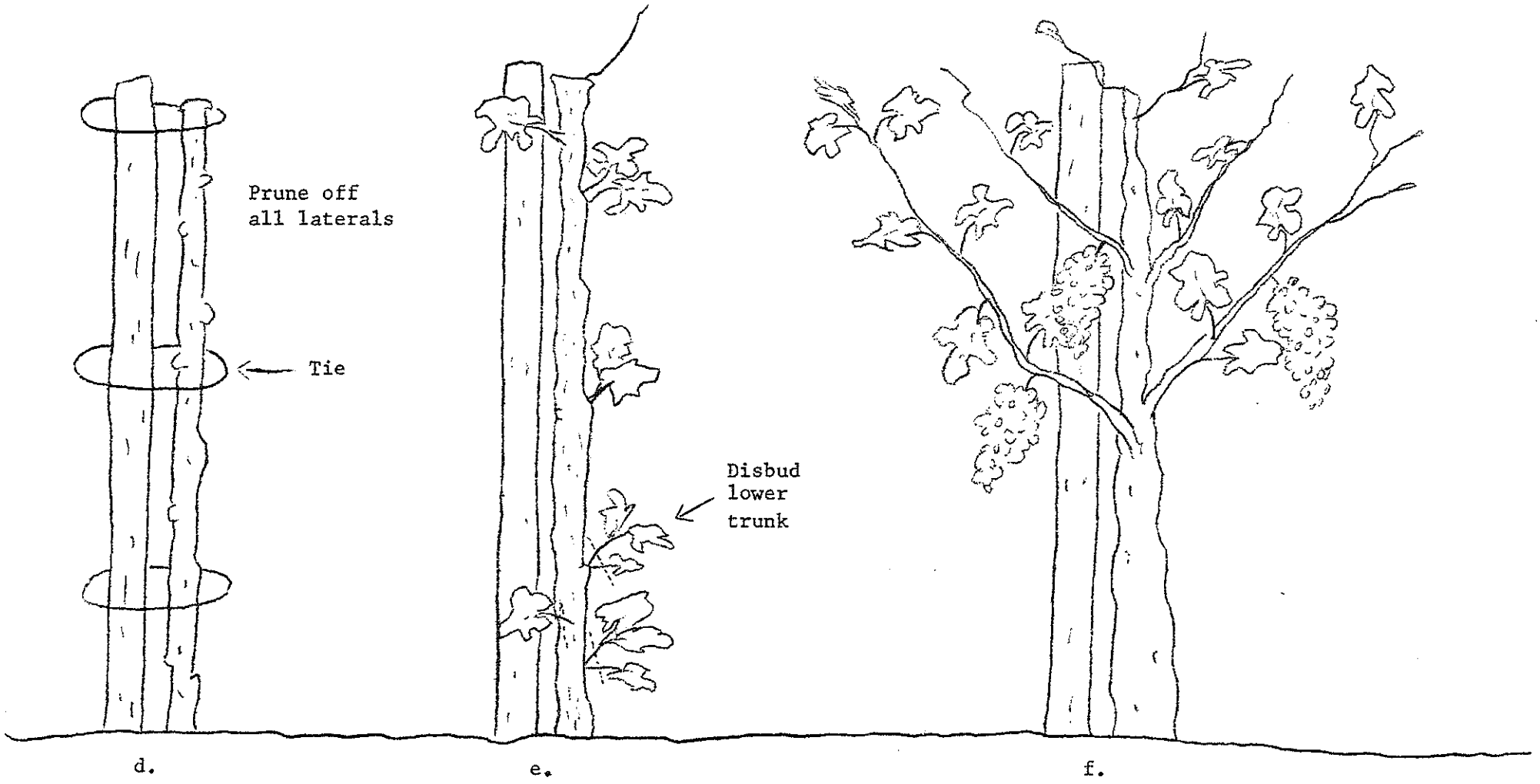


DIAGRAM II

HEAD TRAINING

Fourth Year

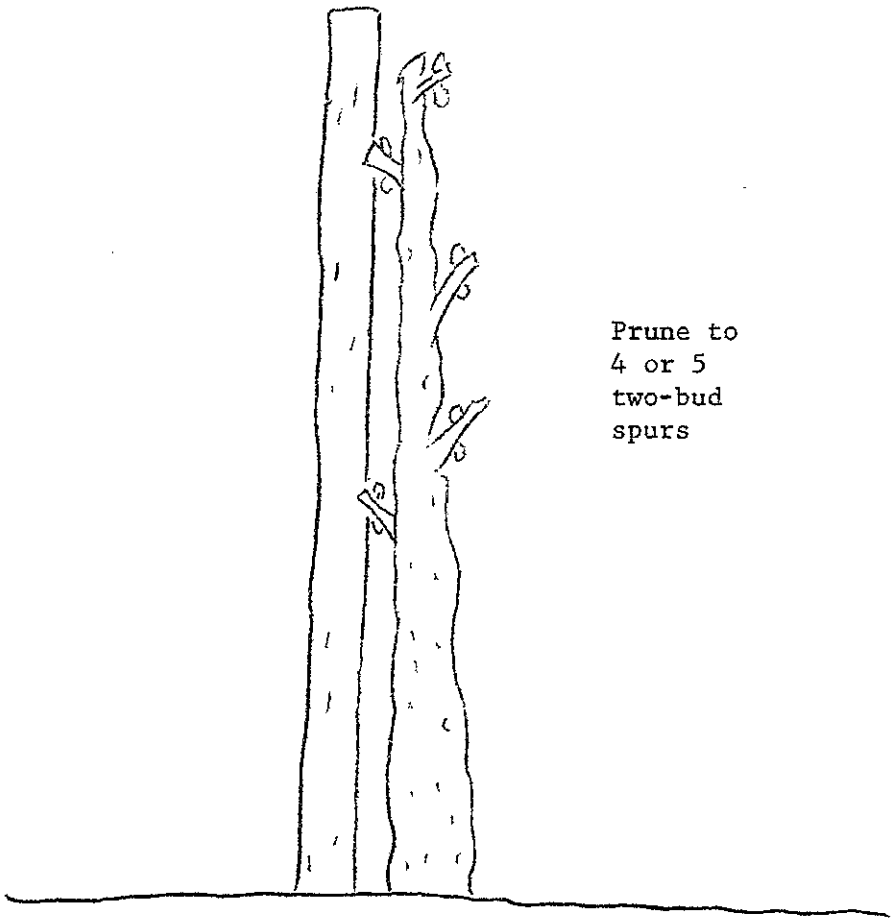


DIAGRAM III

BILATERAL CORDON TRAINING

Second Year

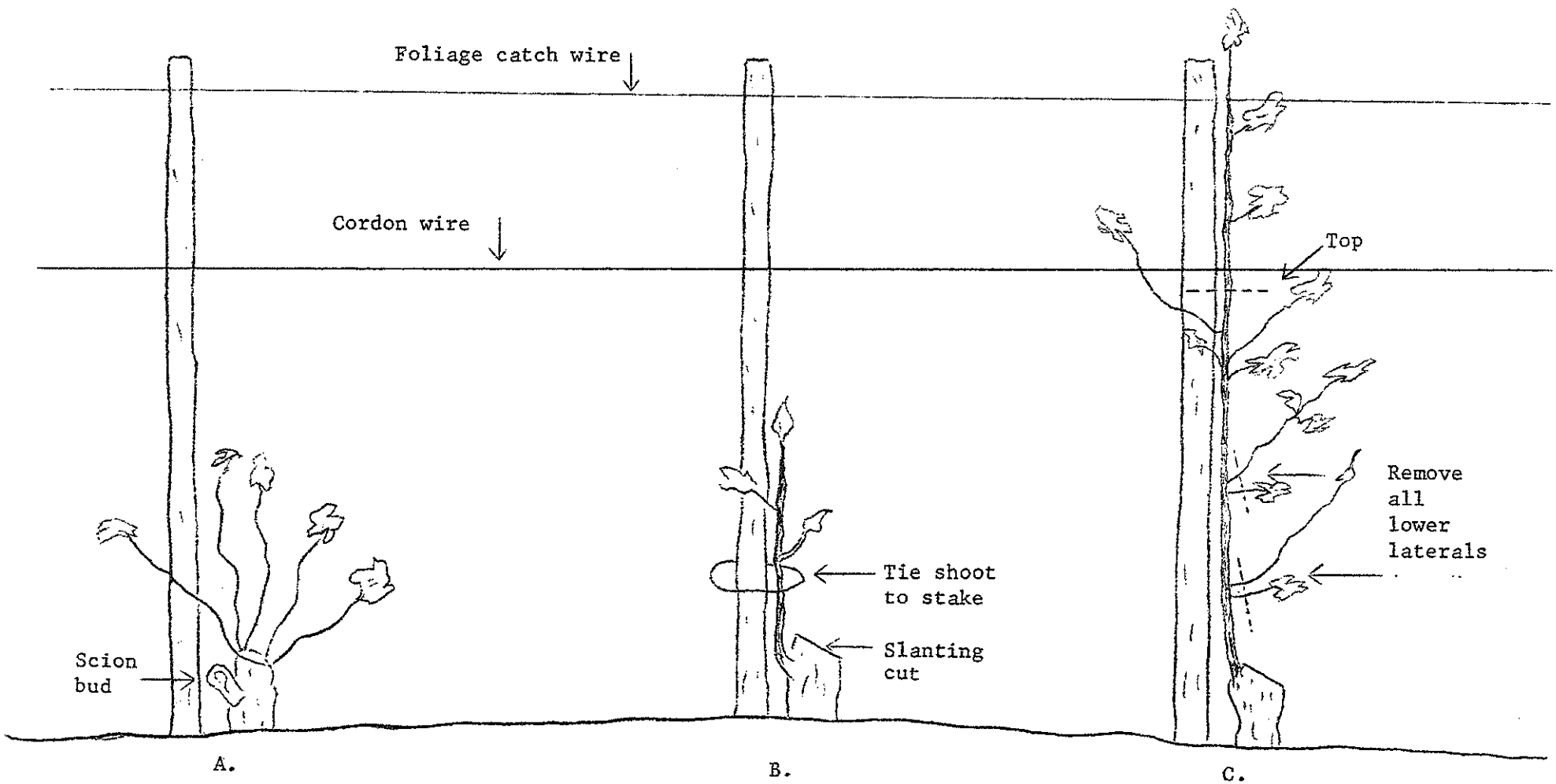


DIAGRAM IV

BILATERAL CORDON TRAINING

Second Year

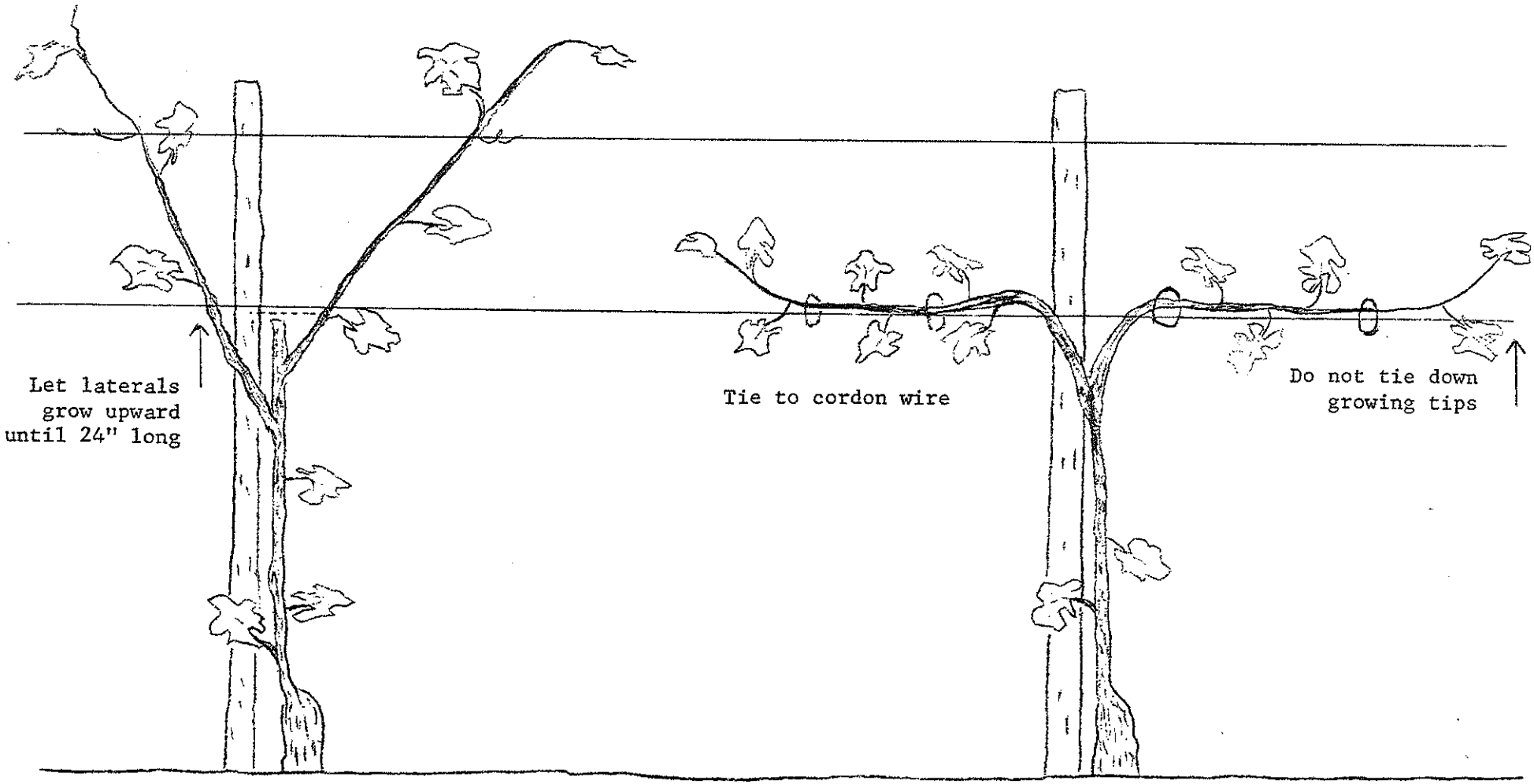


DIAGRAM V

BILATERAL CORDON TRAINING

Third Year

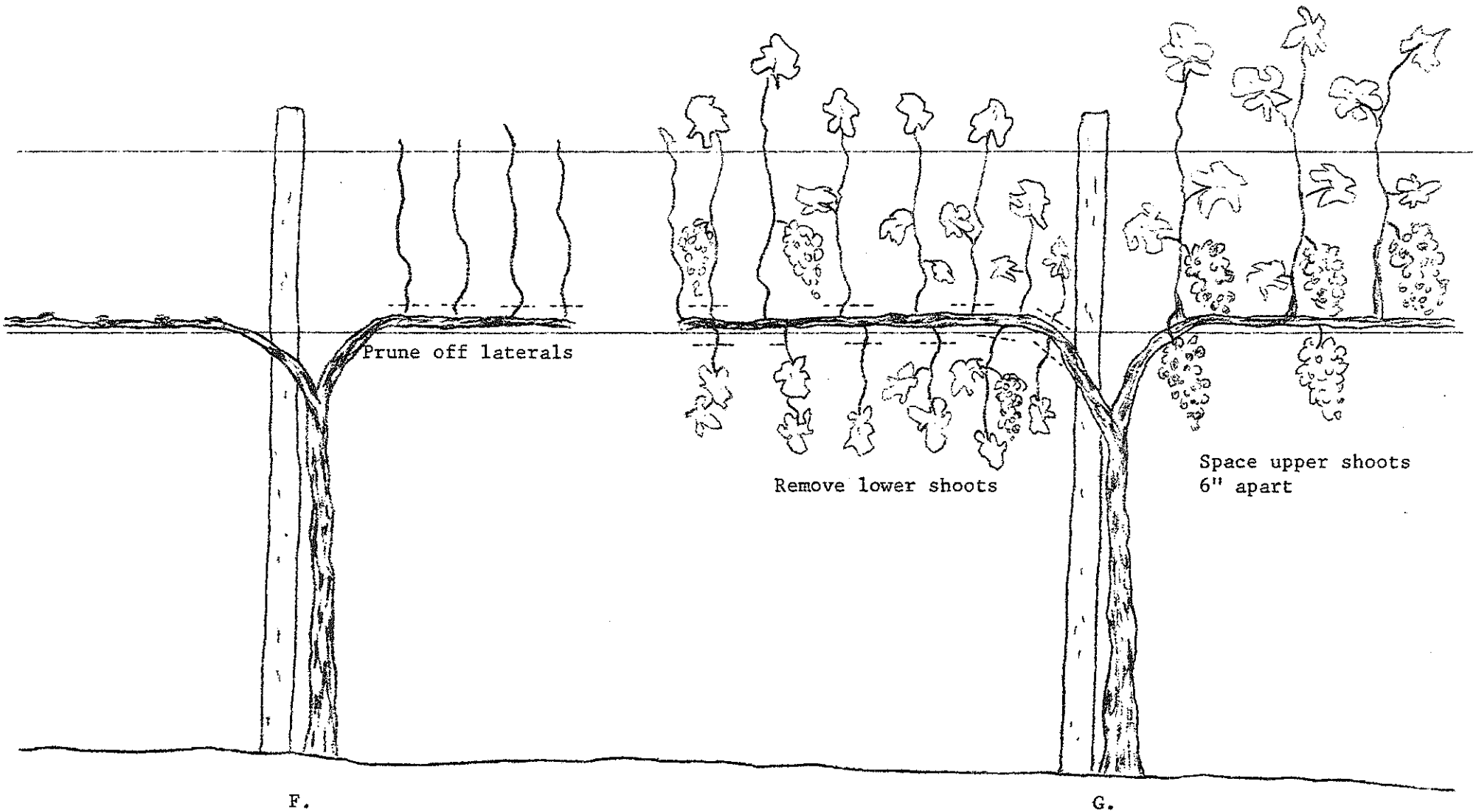
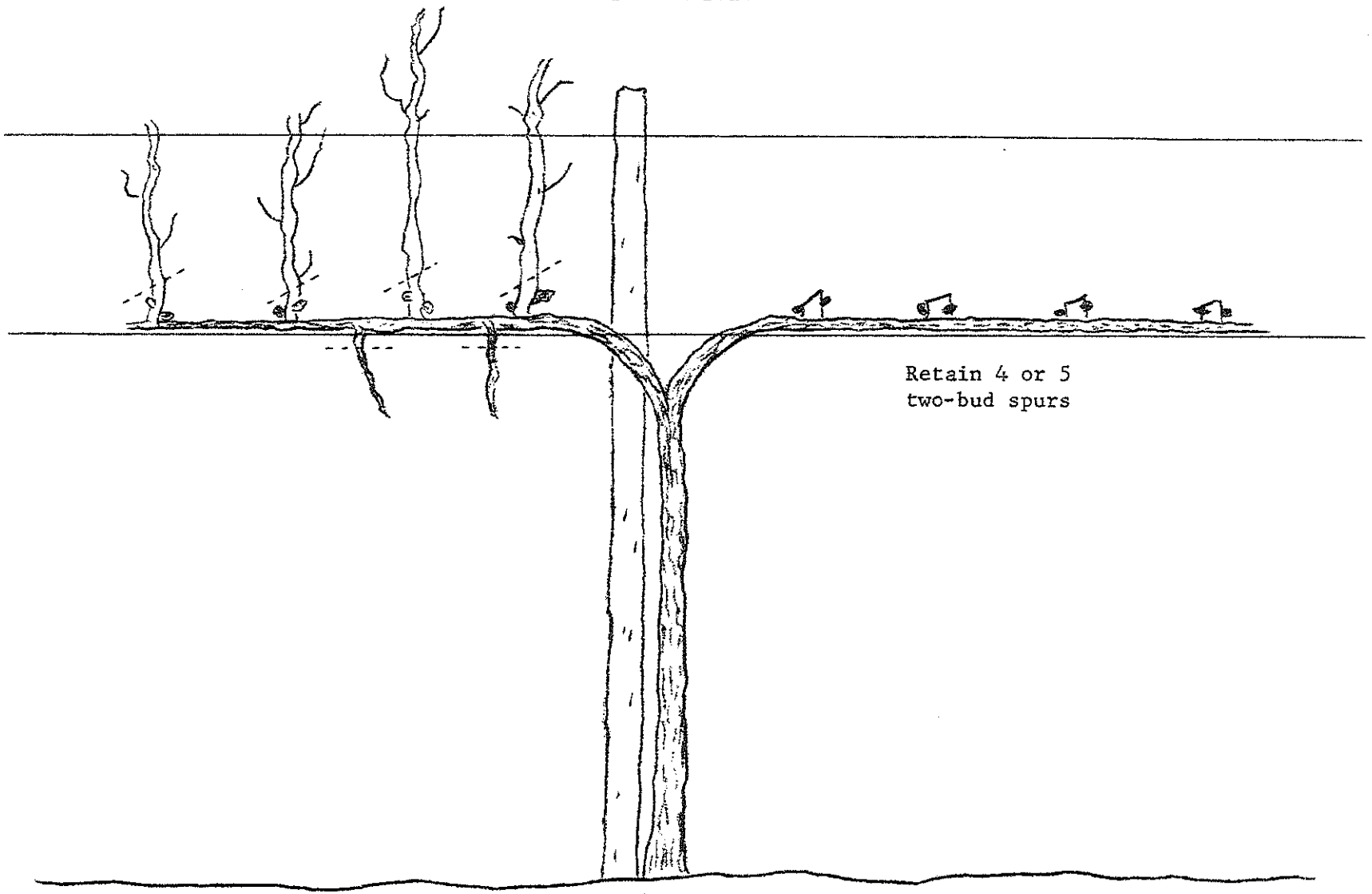


DIAGRAM VI

BILATERAL CORDON TRAINING

Fourth Year



H.

DIAGRAM VII

clusters. Good pruning, adequate trellises, and good irrigation practices all tend to keep vines vigorous and to reduce damage from sunburn and heat injury.

Information on climatic factors can be found in "Climatological Data," published monthly by the U.S. Department of Commerce.

Soil Evaluations

The most common physical soil properties affecting root development and limiting growth of vines are soil depth; soil structure; restrictive zones such as hardpan layers, plow soles, and interfaces (an abrupt change in soil texture); water logging; and water tables.

A source of soil information can be found in published soil survey reports, which are available at farm advisors' offices. By locating a given property on the soil map, you can determine types of soils at the proposed planting site. Soil maps contain information on depth, texture, slope, erosion, surface and subsurface drainage, detailed description of each soil type, depth of rooting, and best crop utilization.

After checking a soil map, then dig a number of backhoe pits to verify the accuracy of the survey map. Backhoe pits and close examination of the soil profile can determine the following:

--Depth of soil to restrictive layers (claypans, hardpans, silt layers, interfaces, plow soles, sandy lenses, etc.)
--Depth of roots from existing crops or native vegetation
--Determine if modification is necessary or if it is possible
--Presence of a high water table
--Presence of water-logging conditions
--Possible salt problems

Collecting soil samples for laboratory analyses can be done easily when the pits are open. Samples should be taken at one-foot intervals throughout the root zone. Have a reliable soil laboratory run analyses to determine pH, total salts (EC_e) and boron, sodium, and chloride levels.

For more soil information refer to Leaflet 2946 "How to Appraise Soil Physical Factors for Irrigated Vineyards" and to Leaflet 21056 "Salinity Appraisal of Soil and Water for Successful Production of Grapes."

Irrigation Water Availability

Most vineyards in California require supplemental water applied during the growing season. The amount of irrigation water needed in general can be stated as follows:

--Irrigation requirement equals evapotranspiration minus effective rainfall plus irrigation losses.

Evapotranspiration (ET) is the water actually used by the vines and through evaporation from the soil surface. Factors that influence ET rates are

--Atmospheric conditions (temperature, wind, and hours of daylight)
--Stage of growth (less growth, lower the ET)
--Total leaf area (the more vigorous the variety, the larger the leaf canopy, the greater the ET)
--Age of vine
--Spacing of vines
--Root condition (nematode or phylloxera infestation cuts back on vigor, less ET)

Irrigation losses refer to water that leaches below the active root zone, that which runs off, and water used by weeds.

Irrigation requirements will vary considerably between viticultural districts in California. Usually the cooler the area, the less irrigation water is needed.

An irrigation supply should be adequate to provide enough water during the peak vine usage period. Usually this is the month of July, where daily needs can be as much as .33 acre-inches. An irrigation delivery system should be designed to cover peak use. Source of water from an irrigation district should be on a frequent enough delivery schedule to provide adequate water during the mid summer period. If frost protection using solid-set sprinklers is necessary, then the supply needed is 50 gallons per minute (GPM) per acre. For example, an 80-acre vineyard will need an output of 4,000 GPM.

Wells used for irrigation should be checked for output and pumping plant efficiency. P.G.& E. customers can have wells checked free of charge.

Water quality should be checked prior to planting and before an irrigation method is determined. Pumps should run for about 1/2 hour before collecting a water sample. Collect about one quart of water in a clean glass container. Have it analyzed by a laboratory for pH, total salts (EC_w), sodium, chloride, nitrate-nitrogen, carbonates, bicarbonates, and boron.

Previous Crop History

Observation of other crops growing on land of the proposed vineyard site can give valuable clues as to problem areas. If crop shows areas of poor growth and low production, find out why. Determine what the problem is and if it can be corrected.

Problems can vary. Some possibilities are soil problems, poor drainage, salt problems, water-logging, nutritional deficiencies or excesses, diseases, nematodes, etc.

A history of previous crop can be helpful in determining if a nematode problem exists. Some crops such as tomatoes are hosts for nematodes. Always take nematode samples prior to planting a vineyard. Find out what nematode species are present to determine if preplant soil fumigation is needed. Parasitic nematodes

have been found in fields where no crops have ever been grown. Some native vegetation can be hosts for this pest.

A sick perennial crop or oak trees can be infected by the disease Armillaria mellea (oak root fungus). If present, remove and burn in place as many infected roots as possible and fumigate prior to leveling or before any other soil movement. Don't spread this disease over the entire acreage.

Biological Problems

Determine what biological problems exist before planting a vineyard.

Nematodes, phylloxera, oak root fungus, and perennial weeds are all biological factors that will have an impact on yield reduction, quality deterioration, and reduced profits.

--Nematodes are slender, active, round worms. Parasitic nematodes that destroy grape roots are microscopic in size. Damage results from feeding on the roots with their hollow, needlelike, mouth parts and causes stunted weakened vines. Laboratory identification of the species present is very important to determine if preplant chemical control measures are needed or what rootstock to use.

Nematode species that are known to cause damage in California vineyards are

Common Name	Scientific Name
Root Knot:	
Cotton	Meloidogyne incognita
Javanese	M. javanica
Root Lesion	Pratylenchus vulnus
Dagger:	
American	Xiphinema americanum
(none)	X. index
Citrus	Tylenchulus semipenetrans

Sampling for nematodes should be done the year before planting. This allows enough time to prepare the soil for an early fall preplant fumigation. Samples of soils and roots should be collected when the soil is moist. Don't expect to find nematodes in dry soil. Discard the air-dry surface layers. Sample trees and vines in the root zone within 1 or 2 feet of the tree or vine, at a depth of between 6 and 18 inches--deeper if necessary to obtain moist soil. Include roots if possible.

Sample row crops in the root zone in the bed at a depth of between 6 and 18 inches--deeper if necessary to obtain moist soil.

Sample bare ground at a depth of 6 to 18 inches--deeper if necessary to obtain moist soil.

Sample with a soil tube or shovel. If using a tube, take 10 to 20 cores from the area sampled--enough to make approximately 1 quart of soil. If using a shovel, take approximately 1/4 cut of soil from near the shovel tip; sample several locations collecting enough soil to make approximately 1 quart of soil.

Sample weak areas in a field on the margins of the spot--the region between the normal and the weak areas. Include roots when possible. A greater number of soil cores in a small area is better for determining the nematode situation in a field. Include no more than 10 acres in a single sample.

Don't store samples in the sun or in a hot car any longer than necessary. Most of the nematodes are killed at temperatures above 110°F. Collect and keep soil samples in plastic bags. This will reduce the possibility of the sample's drying.

Don't ship samples by mail on Thursday or Friday, particularly during the summer, as they may sit in a hot post office over the weekend and the heat will "cook" the nematodes. If a sample is to be held over a weekend, store it in a refrigerator and send out on Monday morning.

Label the samples adequately, and send them to a commercial laboratory specializing in processing nematode samples. (A list of labs is available from Cooperative Extension or your county Agricultural Commissioner's Office.)

--Phylloxera are tiny, yellow-green to yellowish-brown root aphids that feed on new rootlets and destroy the root system. Phylloxera is more of a problem in the heavier loams to clay loam soils; however, they have caused damage in some sandy loam soils. If adjacent vineyards are phylloxerated or if phylloxera is a general pest in the area, then resistant rootstocks should be used. For more information, refer to U.C. publication, Circular 566 "Insect Grape Pests of Northern California" and to Leaflet 2780 "Grape Rootstock Varieties."

--Oak root fungus (Armillaria mellea) - Dead or dying trees or vines should be checked for oak root fungus disease. Look for whitish to cream colored mycelial growth under the bark next to the wood on older roots. Roots on dead vines will have a water-soaked, decayed appearance, with an odor of mushrooms. Infected plants should be pulled and burned in place. Remove as many of the roots as possible. Fumigate before any land leveling, ripping, or other land preparations are attempted. For more information, see Circular 525 "Armillaria Root Rot of Deciduous Fruits, Nuts, and Grapevines."

--Weeds affect vines primarily through competition for water, nutrients, and in some cases, sunlight. The perennial weeds cause the biggest problem in establishing a vineyard. These include field bindweed (morning glory), bermudagrass, Johnson grass, and yellow or purple nutsedge. Eliminate these problems before planting.

--Virus diseases will be no problem in first generation vineyards if certified virus-free planting stock is used. Before replanting a second generation

vineyard, check the old vineyard prior to its removal for virus diseases. Have someone familiar with viruses look for symptoms prior to bloom and again in early fall before harvest. If fanleaf, vein banding, or yellow mosaic (the fanleaf complex) are found, then rotation to another crop may be desirable. These viruses are soil-borne and spread by the nematode Xiphinema index. New plantings can become infected by these viruses if this nematode is present. Obtain professional advice if these conditions exist.

Further information on virus diseases can be found in the text book, "Virus Diseases of Small Fruit and Grapevines," published by the University of California, Division of Agricultural Sciences.

Economic Considerations

--Explore the market potential and determine where you will market before planting. "Have a home for your grapes." Varieties to be planted should be discussed and approved by the winery you will sell to.

--Arrange for financing. A budget and cash flow chart should be developed so that adequate capital will be available when needed for each step of development. University of California sample cost sheets will be helpful in drawing up a budget and projected cash flow sheets.

SECOND GENERATION VINEYARD

There is additional investigative work to be considered before planting a second generation vineyard.

Be sure to determine why the original vineyard failed. Before removing the old planting, locate the weak areas. Check for

--Root pests
- -Nematodes or phylloxera

--Root diseases
- -Oak root fungus
- -Crown gall
- -Drowned out roots

--Soil conditions
- -Salt problem
- -Hardpan
- -Water table
- -Interface (which results in a flat root condition)

--Nutritional problems
- -Potassium deficiency
- -Boron deficiency
- -Zinc deficiency

--Virus diseases
- -Leaf roll
- -Fan leaf
- -Vein banding
- -Yellow vein
- -Corky bark

--Poor irrigation practices

--Competition from weeds
- -Bermudagrass
- -Johnson grass
- -Bindweed (morning glory)

--Poor management

Once you have determined why the original vineyard failed, you should take steps to correct these conditions before establishing a new vineyard. Usually second generation vineyards do better on resistant rootstock, especially if phylloxera or nematode was a major problem. Old roots not removed can be succulent enough to support phylloxera and nematodes up to 8 to 10 years.

VINEYARD DEVELOPMENT

The Preparation Years

Below is a check list of tasks to be done a year or more before planting a vineyard.

☐ Backhoe - Determine suitability of the soil for grape production.

☐ Determine your market outlet and varieties to be planted.

☐ Survey the vineyard site.

☐ Make a scale drawing of the proposed new vineyard. It should include:

--Direction of rows, usually east to west is best
--Row and vine spacing (determined by variety, expected vine vigor, and training method used)
--Row lengths
--Picking avenues and roadways
--Irrigation delivery system
--Drainage system (if needed)
--Loading area

☐ Order vines from nursery. If rooted vines, rootstocks, or dormant bench grafts are to be used, order them 15 to 18 months before planting.

PREPLANTING DECISIONS IN ESTABLISHING A VINEYARD - 8

- ☐ Observe the vineyard from which you are going to obtain cuttings or budwood for crop level, fruit quality, and abnormal foliage symptoms (viruses). If possible, obtain certified propagation wood.
- ☐ Design irrigation system (and drainage system if needed).
- ☐ Take root and soil samples for nematode determination.
- ☐ Check dead or dying vines or trees for oak root fungus disease.
- ☐ Clear the site. Remove old vines, trees, rocks, and shrubs.
- ☐ Control perennial weeds.
- ☐ Rip the soil in two directions. Do this when the soil is dry (fall). You may have to plant a crop to dry the soil out before you rip or slip plow.
- ☐ Level land. If surface irrigation is to be used, you must know the slope needed for your soil type, length, and direction of irrigation runs. Touch-up leveling may be needed for other irrigation methods to improve run-off and drainage.
- ☐ Develop water source. Drill and develop wells where needed.
- ☐ Deep plow.
- ☐ Smooth and work soil in preparation for fumigation.
- ☐ Fumigate for nematodes or oak root fungus. Fumigation should be done when soil temperatures are warm (not below 55°F) and soil is relatively dry. Fall of the year is best.
- ☐ Install drainage system (if needed).
- ☐ Install irrigation system.
- ☐ Plant cover crop to prevent erosion on hillsides (if needed).
- ☐ Install deer or rabbit fences.
- ☐ Lay out and plant vineyard in spring after frost hazard is past.

Good luck!!

WATER REQUIREMENTS FOR GRAPES IN SAN JOAQUIN COUNTY

Acre-inches per Acre

	ET 1/	ESTIMATED WATER REQUIREMENTS 2/	DAILY NEEDS 3/
April	0.5	0.8	.026
May	2.7	4.5	.145
June	3.9	6.5	.21
July	6.2	10.3	.33
August	4.6	7.6	.25
September	2.4	4.0	.13
October	0.6	1.0	.03

1/ Evapotranspiration rate - Loss of water by evaporation from the soil surface and loss through the leaf surface (used by vine).

2/ Estimated water requirement is based on using furrow irrigation with a 60% efficiency.

$$\frac{\text{ET}}{\text{Application efficiency \% in decimals}} = \text{Estimated water requirements in inches}$$

3/ $\frac{\text{Estimated monthly water requirements}}{\text{Number of days in a month}} = \text{Daily needs}$