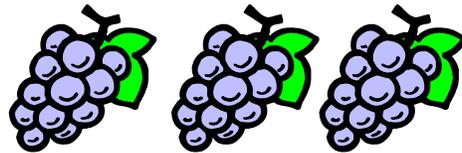


A Pest Management Strategic Plan for Table Grape Production in California



California Minor Crops Council (CMCC)

The California Minor Crops Council (CMCC) received funding for this project from the EPA Region 9 Agricultural Initiative and the USDA Cooperative States Research, Education, and Extension Service (CSREES) Pest Management Alternatives Program (PMAP). CMCC received additional support from the Western Regional Pest Management Center at UC Davis.

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We gratefully acknowledge the contributions of all of these organizations and their participation in this process.

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EXECUTIVE SUMMARY

Introduction

Table grapes are an extremely important commodity in California, both in value and in amount of land planted to this crop. In 2002, the crop had a value of over \$1 billion and accounted for over 97% of national table grape production. Within the state, table grapes account for approximately 16% of all grape tonnage, compared to 59% for wine grapes, and 25% for raisin grapes. The southern San Joaquin Valley, California's major table grape production region, contains 90% of the state's acreage, followed by the Coachella Valley with 10%. While only about 1.5% of the table grapes in California are currently managed using organic farming practices, this sector is rapidly growing.

A large portion of the table grape crop is consumed domestically, but up to 40% of the annual crop is exported. Foreign destinations that present significant opportunities for California growers include Canada, China, Mexico, India, and others.

Table grapes can be impacted by a wide variety of pests and consumers demand large, unblemished fruit. For this reason, pest management in table grapes is quite different or, in some cases, more rigorous as compared to pest management in the wine or raisin grape industries. Insects, nematodes, and diseases (in season and post-harvest) are the major pests that growers must deal with annually. A very productive relationship between the California table grape industry and the University of California has resulted in the widespread adoption of an integrated pest management (IPM) system for this commodity.

New safety standards set forth by the 1996 Food Quality Protection Act (FQPA) will continue to impact the availability and/or use of important crop protection chemicals used by table grape farmers, especially organophosphate and carbamate insecticides/miticides. Furthermore, provisions of the Montreal Protocol, an international treaty, require the phase out of methyl bromide production over the next several years. This extremely effective pre-plant soil fumigant has been a vital tool in California table grape production and alternatives are greatly needed. The table grape industry is working diligently with its state and federal partners to evaluate, register, and/or implement reduced risk production practices in accordance with all of these and other regulatory challenges.

In order to transition to "Reduced Risk" pest management in accordance with FQPA, the Montreal Protocol, and other regulatory actions, the table grape industry is developing long-term approaches to pest management. "Reduced Risk" broadly describes pest management techniques and tools that are safe for consumers, field workers, and the environment. This "Pest Management Strategic Plan (PMSP)" identifies the most critical issues of in the areas of research, registrations, and education.

In 2002, several members of the industry met to focus specifically on the pest management needs of California table grapes. A work group was formed to evaluate the all areas of table grape pest management including insects, spiders, mites, diseases, weeds, nematodes and vertebrates. The coalition consisted of growers, packers, shippers, Pest Control Advisors (PCAs), Farm Advisors, and researchers. The work group also included agency personnel from USDA, EPA, Western Region IR-4, and the Western Region Pest Management Center at UC Davis. The discussions held at this meeting provided the basis for a "Pest Management Strategic Plan for California Table Grapes". This plan contains a comprehensive summary of the California table grape industry's crop production and pest management practices, as well as information related to the importance of pesticides and alternative pest control strategies needed in the future. The foundation for this strategic plan includes two very important documents: UC Publication 3343 - *Grape Pest Management* and the *Crop Profile for California Table Grapes* (<http://pestdata.ncsu.edu/cropprofiles/docs/cagrapes-table.html>).

The California table grape industry intends that this document be used as a resource by EPA, USDA, CDPR and other agencies as they inquire about pest management issues, needs, and practices in California; this strategic plan will be periodically updated to remain current with industry developments and issues. For follow-up inquiries, contact information for work group members is provided in the Appendices.

The mention of any product in this strategic plan does not represent endorsement by any member or organization within the California Table Grape Work Group. Chemical and trade names for products used in table grapes are listed in the efficacy tables in the Appendices.

Stakeholder Recommendations

As a result of the industry meeting held in 2002, the working group identified the following research, regulatory, and educational priorities. These critical areas must be addressed to maintain the economic viability of the table grape industry in California.

Research Priorities

Finding effective and economical pest control solutions that are safe for workers and the environment is a high priority for table grape growers in California. Research is needed also on basic soil and plant health, as these factors relate to pest susceptibility. In particular, information is needed on black measles, Spanish measles, and new crop-safe herbicides; new products, especially those which are biologically based, should be evaluated. Resistance management strategies should be developed, especially for insecticides and miticides. As methyl bromide is phased out, alternatives to this highly effective product must be identified for both pre-plant and quarantine uses of this product.

- Develop pest control techniques which are effective, economical, and environmentally sound
- Develop resistance management strategies for insecticides and miticides (especially new neonicotinoid products)
- Develop biologically-based pest control products and techniques
- Study the biology and management of vine mealybug, Pierce's disease, black measles, Spanish measles, and black widow spiders
- Identify herbicides that are safe for vines
- Evaluate methyl bromide alternatives
- Expand information on the relationship between improved soil and plant health as it relates to the ability of the vines to withstand pest pressures

Regulatory Priorities

The table grape industry needs new products to replace methyl bromide for control of vine mealybugs, nematodes, and weeds. A critical use exemption (CUE) and quarantine pre-shipment (QPS) exemption should be submitted to EPA and approved until suitable replacements for methyl bromide are available. As new products enter the registration pipeline, the registrants and EPA should work together to comply with all international registration requirements (MRLs, NAFTA, Codex provisions, etc).

- Expedite registrations of products to control vine mealybugs, sharpshooters and black widow spiders
- Expedite registrations of pre-plant fumigants and nematicides
- Expedite registrations of pre-emergence and post-emergence herbicides
- Maintain availability and use of methyl bromide until proven alternatives (economic and technical) are in place through Critical Use Exemptions (CUEs) or quarantine pre-shipments (QPS) as needed
- Resolve export issues concerning quarantine and market access
- Establish Codex MRLs early in the product registration phase for new chemicals being registered in the U.S.

Educational Priorities

The public, including regulators and consumer groups, must be educated about the use of sustainable agricultural practices and Integrated Pest Management (IPM) in California table grape production, and how this system optimizes food production, environmental protection, and worker safety. Education is needed for growers and PCAs on viticulture, new products, and drift mitigation. Finally, the public should be reminded through effective media campaigns (e.g., “Buy California” and “Five a Day” programs) that the consumption of fresh fruits and vegetables, particularly table grapes, contributes to a nutritious diet and a healthy lifestyle.

- Educate regulators regarding the intensive efforts that growers are making to manage vine health and vigor to help alleviate pest susceptibility and damage
- Continue to educate growers, PCAs, and PCOs on safe and efficient application techniques
- Continue to educate growers, PCAs, workers, and the public on sulfur drift mitigation
- Educate the public through effective media messages that the consumption of fresh fruits and vegetables, particularly table grapes, contributes to a nutritious diet and healthy lifestyle

The California Minor Crops Council (CMCC) received funding for this project from the EPA Region 9 Agricultural Initiative and the USDA Cooperative States Research, Education, and Extension Service (CSREES) Pest Management Alternatives Program (PMAP). CMCC received additional support from the Western Regional Pest Management Center at UC Davis.

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California Minor Crops Council (CMCC)

November 2003

A PEST MANAGEMENT STRATEGIC PLAN FOR CALIFORNIA TABLE GRAPES

1. CALIFORNIA TABLE GRAPES: PRODUCTION OVERVIEW

California is the number one state for table grape production in the United States, and accounts for over 10% of the world table grape production. Currently, at least 120,000 acres in California are devoted to growing varieties to be used solely as table grapes (versus those designated as wine, raisin, or unspecified grapes).

- **Production:** California is ranked number one in production of table, wine, and raisin grapes in the United States, producing 97% of the table grapes grown in the United States (greater than 10% of world production).
- **Acreage:** California table grape acreage in 2002, about 120,000 acres plus some portion of the more than 16,000 acres of “unspecified” varieties, accounts for about 16% of all grape acreage (table, raisin, and wine) in the state.
- **Value:** The combined grape crop (table, wine, and raisin grapes) is the number two ranked commodity in California, following dairy production, and exceeds \$3 billion. Table grapes alone exceed \$1 billion (freight on board, i.e., not retail value).
- **Varieties:** Thompson Seedless, Flame Seedless, Red Globe, and Crimson Seedless grapes are the primary table grape varieties grown in California, although over 50 varieties are produced.
- **Growing Regions:** About 90% of California's table grape production is in the Southern San Joaquin Valley region, with the Coachella Valley region accounting for most of the remaining production.
- **Primary Counties:** The major table grape production counties are Kern, Tulare, Riverside, and Fresno, with much smaller production from Madera, San Joaquin, San Bernardino, Kings, Merced, and Imperial counties.
- **Organic Production:** Organic farms account for 1.5% of the total grape growing acreage in California.
- **Exports:** In 2002, exported table grapes totaled almost \$375 million, with primary destinations being Canada, China/Hong Kong, Malaysia, and Mexico (~40% of the total crop).

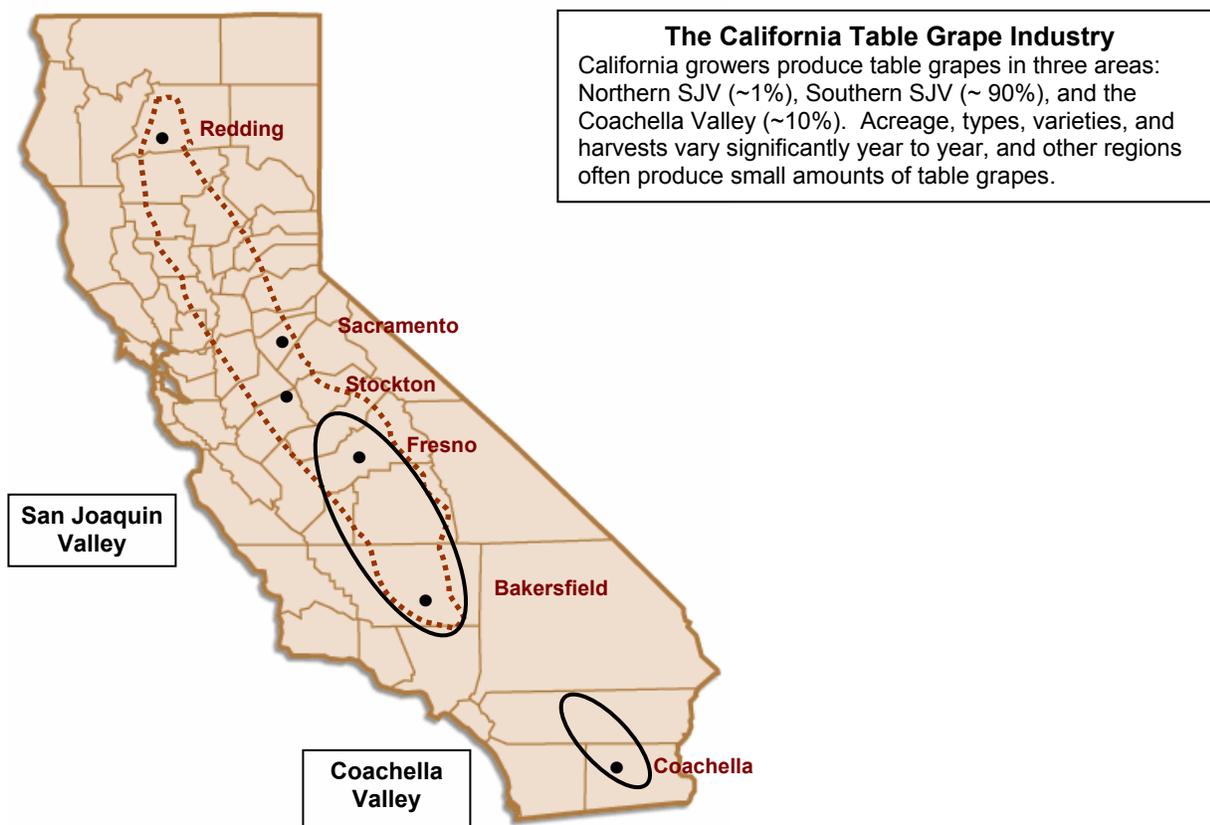
It is important to distinguish table grape production from wine and raisin grape production because cultural practices and pest management issues for these three types of grapes differ significantly. Pest management priorities are also impacted by the intended use of the grapes; for example, control of pests that cause cosmetic damage to the fruit can be much more important in the production of table grapes than in wine and raisin grapes.

There are two major regions of table grape production in California: the San Joaquin Valley and the Coachella Valley. The San Joaquin Valley produces 90% of total table grapes harvested; it includes Fresno, Kings, Tulare, Kern, and Madera counties. The Coachella Valley includes the Coachella regions of Riverside and Imperial counties, but the majority of table grapes are produced in Riverside County, which provides 10% of total table grape harvest. Compared to the San Joaquin Valley, this region has a much earlier crop.

The remaining regions of California account for less than 1% of the state's table grape production. The Northern San Joaquin Valley produces less than one percent of total table grapes, primarily in San Joaquin County. On a year-by-year basis, there is some shifting in the grape types grown in individual counties, depending on market conditions.

Location of Table Grape Production. Table grapes are most productive on loam-textured, deep, uniform soils. California table grape production areas are shown in Figure 1. Timelines for crop development, cultural practices, and pest management activities are provided in Appendices 2 and 3.

Figure 1: Table Grape Production Regions in California



Viticultural Practices. Vineyards for table grape production average about 80 acres each, but can range from 20 to 200 acres and larger. This number, of course, is quite variable, according to grower and size of operation. Vines are planted with a spacing of 7 feet by 12 feet, and there are generally 400 to 500 vines per acre.

Small vines are transplanted to the field from the nursery and, depending on the desired variety and local pest issues, the most appropriate rootstock and scion (fruiting variety that is grafted onto the rooting stock) combination is used.

Vines are pruned during the dormant season and, for cane-pruned varieties, canes are tied to the trellis wires before spring growth starts. Drip irrigation has recently become the preferred method of irrigation, though furrow irrigation still dominates in the southern San Joaquin Valley. Other production practices include canopy management (e.g., vine training, shoot positioning, leaf pulling, and trunk suckering), vineyard floor management (e.g., cover cropping, cultivation, and mowing), pest management, and harvesting. Insect, mite, and disease pests can be treated throughout the year, during dormancy and in season. Pre-emergent herbicides are applied during the dormant season; most contact herbicide applications are made from fall through summer. Nitrogen and zinc fertilizers are applied in the spring, with potassium and boron fertilizers applied in fall through winter. Cultural practices such as irrigation and floor management can play a role in pest management. At harvest, the grapes are picked, inspected, field packed, placed in cold storage, fumigated with SO₂, and transported to markets.

It generally takes three years after transplanting for a vineyard to come into commercial production; vines can remain in commercial production for over 60 years.

Table Grape Varieties in California. Over 50 varieties of table grapes are grown in California, but Thompson Seedless is the single most important grape variety for raisin and table grape production. In recent years, Flame and other seedless grapes have become much more popular; Red Globe, Ruby Seedless, Crimson Seedless, and Perlette are other important table grape varieties.

Differences in the Major Table Grape Production Areas of California

CHARACTERISTICS	SAN JOAQUIN VALLEY	COACHELLA VALLEY
Soil Types	Light to medium	Sandy
Relative Air Temperatures	Hot	Very hot
Annual rainfall	10-12 inches	3-4 inches
Main Varieties	Thompson, Flames, Red Globe, Crimson Seedless	Thompson, Flames
Other Grapes Grown	Wine, Raisin	Raisin
Dormancy	late November – early March	early December – early February
Bud Break	March	February
Bloom	May	early April – early May

Note: Summary table based on “average” years

Rootstock Selection for Table Grapes. Rootstock selection is critical in establishing vines that are well suited to the various soil types, moisture conditions, pest resistance or tolerance, and location.

Important Pests in California Table Grape Production. Many pests and diseases can attack grapevines and reduce the yield and quality of the harvest, or impact the post-harvest quality of the fruit. Young vineyards are particularly susceptible to damage. The introduction of exotic pests has made it more difficult and expensive to produce grapes in some areas of the San Joaquin Valley. The following table lists the pests considered most important to table grape growers.

CATEGORY	IMPORTANT PESTS IN TABLE GRAPES
Insects	leafhoppers, mealybugs, thrips, omnivorous leaf roller, <i>Phylloxera</i> , sharpshooters
Spiders & Mites	black widow spiders, spider mites
Diseases	powdery mildew, <i>Botrytis</i> bunch rot and post-harvest sour rot, <i>Phomopsis</i> (<i>Phomopsis viticola</i>) cane and leaf spot, measles, eutypa dieback (<i>Eutypa armeniacae</i>), canker, Pierce’s disease
Weeds	annual grasses, Johnsongrass, Bermuda grass, field bindweed, mustard, nutsedge, nightshade, white-stem filaree, flax-leaf fleabane
Nematodes	root knot, ring, dagger, lesion, citrus
Vertebrates	birds, gophers, voles, meadow mice, squirrels, rabbits

Vineyard Floor Management. Weeds in the vine rows and middles are managed with several cultural techniques, including disking, mowing, and application of herbicides. Vineyard floors are mowed up to four times from March through August, and vine row weeds are controlled with pre-emergence herbicide strip sprays in the winter. Escapees are treated by spot sprays during the summer months.

Canopy and Fruit Size Management. During the winter, the vines are pruned and the plant debris is shredded. In spring, suckers and sterile shoots are removed from the vine trunks and crowns. Tactics used to increase fruit size and aid in managing pest severity include thinning flowers and berries, girdling, and applying plant growth regulators (PGRs).

Use of Sprayers in Vineyards. Ground spraying of vines is most often accomplished through one of three types of equipment: 1) over the vine, high pressure sprayers that cover two complete rows; 2) air carrier, single row sprayers that treat one-half of each adjacent row; and 3) air carrier double row sprayers that cover four half rows or two complete rows. Over the vine applications are usually made with from 150 – 400 gallons of spray per acre. Concentrated and semi-concentrated sprays are applied at rates of 10 to 100 gallons per acre. Efficacy of all materials is determined by accessibility of the pest, vine canopy architecture, weather, and proper chemical selection.

Use of Fertilizers. Table grapes are generally fertilized once in the spring and again in the fall, with rates adjusted to vine vigor as monitored by tissue analysis. Multiple, light applications of fertilizer through a drip irrigation system are optimal.

Use of Plant Growth Regulators (PGRs). Plant growth regulators are important tools in crop management, used to thin the fruit and to increase its size. Applications of PGRs start at a prescribed time according to bloom, and are usually made at least twice during the early part of the season.

Worker Activities. Table grapes, like most specialty crops, require many cultural activities throughout the year, as well as pest monitoring and management activities. Grape yield and quality depend upon the grower's practices. Most growers retain experts in various areas (irrigation, nutrition, pest control, etc.) in order to manage the grape crop to reach its maximum potential. Cultural activities performed by vineyard workers include cultivation, irrigation, pruning, thinning, canopy management, frost protection, girdling, fertilizer applications, cover crop management, harvesting, and soil and plant tissue analysis for nutrient content. Pest management activities performed by vineyard workers include monitoring vineyards throughout the entire year; scouting for insect, disease, weed, and nematode pests; plowing; cultivating; applying pesticides and growth regulators; releasing beneficial organisms; and monitoring border crops.

2. PEST MANAGEMENT FOR ESTABLISHED TABLE GRAPE VINEYARDS

The following section tracks the progression of table grape crop development in California and provides information on typical field activities and important pest issues during these time periods. The work group identified the following seasonal intervals which are important in terms of viticultural and pest management events:

- Dormancy (Winter)
- Bud Break through Berry Development (Spring – Summer)
- Harvest (Summer – Fall)
- Storage/Post-harvest (Summer – Fall)
- Post-Harvest Activities in the Vineyard (Fall)

The remainder of this document is an analysis of pests, regional and seasonal occurrences, agronomic practices, and pest management tools used during the various stages of table grape production. Some sections will be divided by area or season to describe regional differences. A calendar of seasonal pest occurrence, pest management field activities, and cultural practices is provided in Appendices 2 and 3.

This portion of the strategic plan will begin with pests of the dormant period and go through the post-harvest issues of table grapes. The critical issues of the table grape industry will be summarized at the end of this section. These topics are categorized as they pertain to the related research, regulatory, and educational issues as they pertain to pest management.

Table Grape Development in Major Production Areas

Stage	Dormancy	Bud Break through Berry Development	Harvest	Storage
Season	Winter	Spring – Summer	Summer-Fall	Fall - Winter
Length	~3 mos.	~6 mos.	15-20 days	14-28 days
San Joaquin Valley Timing	December – March	March – July	June – mid November	September – January
Coachella Valley Timing	December – February	February – May	May - early July	July – August

Note: Summary table based on “average” years

DORMANCY (Winter)

Vines enter a dormant period after the leaves are killed by frosts in late fall. Several cultural and pest management activities take place during this time to prepare for the next season's crop.

Cultural and Worker Activities

<ul style="list-style-type: none"> • Pruning and tying • Monitoring for insects (e.g., mealybug, GWSS) • Mechanical preparation of berms • Trellis repair • Vine replacement 	<ul style="list-style-type: none"> • Irrigation system repair • Application of residual herbicides after pruning • Preparing frost furrows • Planting cover crops
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INSECTS AND MITES

It is important to know prior to the dormant season what insect and disease pests should be monitored during this period. If vineyards have had problems in the previous season with certain pests (e.g., mealybug), control measures should be taken during the dormant period when pesticides are most effective. Populations of GWSS must be monitored also in neighboring crops such as citrus and alfalfa. All applications of insecticides and herbicides occur after pruning and tying prior to bud break. Sanitation can aid in the general reduction of pests, weeds, and diseases. Sanitation alone will not completely control a particular problem, but can assist in lowering its incidence or severity.

No biological controls are available for grape and vine mealybugs. Currently, only three chemical tools, are available: Lorsban® provides good control; Imidan® and lime-sulfur provide only poor to fair control.

No biological or cultural controls are available for true bugs (boxelder, lygus, stinkbugs).

Treating GWSS in alternate host crops such as citrus effectively protects table grape vineyards. The use of parasitic wasps and resistant cultivars is being evaluated.

Leucanium scale and woodborers are only isolated pests of table grapes. Lorsban® provides good control of scales and fair control of woodborers; oil provides only poor control of scales.

Work Group Recommendations for Insect Management during Dormancy

RESEARCH	<ul style="list-style-type: none"> • Evaluate new chemistries for broad spectrum insect control, especially for mealy bugs
REGULATORY	<ul style="list-style-type: none"> • None
EDUCATION	<ul style="list-style-type: none"> • Use public media to increase public awareness of key pests such as GWSS

WEEDS

Weed control during the winter dormant season consists largely of using residual herbicides and cultivating to reduce annual weeds. Contact herbicides are used as weeds germinate in the spring. Non-chemical controls for weeds include cultivation, water management, use of cover crops, and hand weeding.

The following weeds are of the greatest concern at this time of the year.

Annual bluegrass	Henbit	Mallow
Burning nettle	Filaree	Mustards
Bermuda grass	Fleabane	Nutsedge
Bindweed	Johnsongrass	Shepherd's purse

Princep[®], Karmex[®], and Solicam[®] all work well, but there are state restrictions on the use of these herbicides. Surflan[®] is a good pre-emergence herbicide, although it is expensive and has limited availability; generic oryzalin is now available from FarmSaver.com and others.

The "French plow" as a cultural technique for row plowing is not widely used because it can damage irrigation drip lines and the vines' root systems. The French plow also is expensive and uses a great deal of fuel because multiple passes are required through the vineyard. Flaming is a fairly effective technique, but is not widely used and also causes air quality concerns. Shallow cultivations provide good control of most weed species found in vineyards.

Work Group Recommendations for Weed Management during Dormancy

RESEARCH	<ul style="list-style-type: none"> • Develop new herbicides that are not dependent on rainfall • Research mulches and their benefits to production (systems approach) • Develop new herbicides
REGULATORY	<ul style="list-style-type: none"> • Expedite full bearing registration for Prowl[®] • Expedite full bearing registration for Visor[®] • Expedite full bearing registration for Milestone[®]
EDUCATION	<ul style="list-style-type: none"> • Provide training on use of pre-emergence herbicides and how to avoid groundwater problems • Increase the number of farm advisors available to growers and PCAs; maintain funding for research and extension programs • Registrants should provide timely technology transfer meetings for new products

DISEASES

Diseases which need to be monitored and/or treated in the dormant period include *Phomopsis*, black measles, Pierce’s disease, and Eutypa dieback. Maintaining vine vigor, practicing good sanitation, and pruning at the proper time during dormancy can help to manage certain diseases.

Phomopsis cane and leaf spot, fungal diseases, can be reduced by pruning out infected wood during the dormant season. Benlate® works well, but it has been cancelled; however, no other *Phomopsis* materials are registered.

Black measles are most serious in plantings which are ten years old or older. It is thought that the unknown causative organisms enter the vines through pruning wounds. Accordingly, diseased vines should be removed before pruning other vines in an orchard. No chemicals control black measles.

Pierce’s disease (PD) is best treated by removing weeds, which serve as alternate hosts for this disease, and by managing vectors (sharpshooters, especially glassy-winged sharpshooters). No chemical control for Pierce’s Disease is available.

Eutypa dieback can be reduced by pruning infected wood when dry.

Work Group Recommendations for Disease Management during Dormancy

RESEARCH	<ul style="list-style-type: none"> • Evaluate replacements for Benlate® for control of Eutypa and other canker diseases • Conduct research on non-host cover crops to manage Pierce’s Disease • Evaluate management and control options for measles
REGULATORY	<ul style="list-style-type: none"> • Expedite Topsin® registration for control of Eutypa and other canker diseases • Continue discussion with registrants about propiconazole (Nectec®) for Eutypa
EDUCATION	<ul style="list-style-type: none"> • Provide training to growers on identification of Pierce’s Disease and what they should do if they find the disease in their vineyard • Educate growers and PCAs on the important role they play in identifying and managing Pierce’s Disease

NEMATODES

Three species of nematodes can be significant in table grapes: root knot nematodes (*Meloidogyne* spp.), dagger nematodes (*Xiphinema* spp.), and occasionally ring nematodes (*Criconemella* spp.). Nematodes damage vines directly by disrupting water and nutrient flow throughout the vine or by transmitting viruses to the vines. Maintaining good vine vigor is recommended, as is soil monitoring to determine whether nematode numbers are reaching densities which warrant treatment later in the production cycle.

The use of a nematode tolerant or resistant rootstock is a foundation for nematode management over the life of a vineyard. The loss of methyl bromide as a fumigant for new vineyards presents significant concerns for managing plant health and nematode management throughout the life of a vineyard.

During dormancy, using cover crops and reducing levels of organic matter in the vineyard are fairly effective cultural techniques to manage all nematodes. With the loss of Nemacur®, new nematicides are greatly needed.

Work Group Recommendations for Nematode Management during Dormancy

RESEARCH	<ul style="list-style-type: none">• Evaluate new nematicides• Conduct research on soil health and antagonistic organisms• Evaluate benefits of trap (cover) crops• Conduct studies to determine the relationship between higher organic matter content in the soil and nematode problems
REGULATORY	<ul style="list-style-type: none">• Expedite the registration of new nematicides
EDUCATION	<ul style="list-style-type: none">• Educate growers about root stocks and the nematode species they affect• Educate regulators about the effects of root stock and variety limitations on table grape quality

VERTEBRATE PESTS

Vertebrate pests can feed directly on the bark and inner tissues of grape vines. They can also be disruptive to irrigation and other equipment used in the vineyards. Vineyards near fields, pastures, and trashy areas are especially susceptible; therefore, sanitation in and around vineyards is important. Monitoring for damage and presence of vertebrates is important even during the dormant period.

Several control techniques are used with variable success for vertebrate control. Butane/oxygen blasters and traps provide fair to good control of gophers and ground squirrels; poison baits (strychnine) are also effective on gophers, and boom guns provide fair to good control of ground squirrels. Bait stations are fairly effective in controlling vertebrate pests, and shooting, which is occasionally used, provides good control. Shooting and trapping are effective techniques to manage coyotes that cause problems in vineyards.

There are no current work group recommendations for vertebrate management during vineyard dormancy (winter).

BUD BREAK THROUGH BERRY DEVELOPMENT (Spring – Summer)

As temperatures rise in February and March, a period of great shoot growth begins, followed by flowering and development of berries during the late spring; then sugar accumulation and berry sizing occur as the season warms.

Cultural and Worker Activities

• Pruning	• Fertilization	• Irrigation
• Shoot thinning	• Flower cluster thinning	• Crop load adjustment
• Berry thinning	• PGR applications	• Pesticide applications
• Leaf pulling	• Canopy maintenance – move wires and canes	• Monitoring

INSECTS AND MITES

Monitoring must be initiated early in the season for spider mites, skeletonizers, omnivorous leaf rollers, and mealybugs. Thrips tend to be a problem mainly at bloom. Other insects, such as leafhoppers, need to be monitored the entire season until harvest. *Phylloxera* tends to be active in the later part of the season. Glassy-winged sharpshooters are active throughout the season. Non-chemical methods for insect and mite control during the season include the use of natural enemies, irrigation and dust management, and sanitation.

Pacific spider mites are a major problem in vineyards and the predominant mite species found in table grapes. Willamette and two-spotted mites are less problematic. Several cultural and natural controls help to minimize mite problems. Avoiding stress (i.e., maintaining good water and nutrient levels in vines) will make the vine more resistant to or tolerant of mite build-ups. Minimizing dust around fields will also help to reduce problems with mites; mowing grass instead of cultivating helps with dust control. Predatory mites work well on Pacific spider mites, but not as well on Willamette mites. Avoiding the use of pyrethroid insecticides is important, as these disrupt beneficials and encourage the development of mite problems. Reducing the use of sulfur also reduces mite problems.

Agri-Mek® provides good mite control, but it is somewhat slow acting and must be applied early. Omite® is a good miticide, but occasionally produces problems with worker sensitivities and phytotoxicity, and it has a long re-entry interval (REI). Kelthane® provides only poor to fair control of mites and is harsh on beneficials. Acramite® is effective as a contact miticide, which is most effective when mite populations are low. Danitol® provides fair to good mite control and is best when used on low populations; it may negatively affect beneficials. Vendex®, a poor to fair miticide, is best used on low populations, and is temperature sensitive.

Glassy-winged sharpshooter (GWSS) has become a critical concern in recent years due to its ability to spread Pierce's disease. GWSS can be controlled well with Sevin®, but Sevin® is disruptive to beneficials and may cause mite populations to flare up. Admire® provides excellent control for several months; after this time, there appears to be only some repellency of GWSS. Provado® provides good control of GWSS, but has a shorter residual than Admire®. Surround®, a kaolin clay used as a barrier, provides fair control of GWSS. This product can be applied up to bloom and post-harvest; it is also approved for use in organic vineyards. Pyrethrum provides fair control of GWSS and is organically approved.

Using a Bug Vac®, a device to physically suck insects out of the vines, is only fairly effective, as insects are scared away before they are captured. Also, this technique is expensive. Lannate®, Dibrom®, dimethoate, and Danitol® all provide good levels of control of GWSS. Lannate® and Dibrom®, however, do not have any residual activity.

Thrips can be treated with Lannate®, which provides good control, although this material is harsh on beneficials. Pyrethrum is approved for organic use, but provides only fair control. This product is moderate to soft on beneficials. Danitol® provides good control of thrips.

Leafhoppers can be controlled with Provado® and Admire®, which provide good to excellent efficacy; however, there is great potential for resistance with these products. Pyganic®, approved for use in organic vineyards, and Thiodan® both provide fair levels of control. Lannate® and Dibrom® will control leafhoppers, but these products are generally not used exclusively for leafhoppers.

There are some effective natural or biological control agents for leafhoppers. *Anagrus* parasites will control low populations of some leafhoppers; however, this parasitoid does not kill the variegated leafhopper, which is the most common species. Lacewings can be released to provide fair levels of control. Removing infested leaves can aid in control. Sticky traps, used to capture migrating leafhoppers, are moderately beneficial in reducing their populations.

Omnivorous leaf roller (OLR) and other lepidopterans can be controlled with good to excellent efficacy with Kryocide[®], which has a longer residual than Confirm[®]. Confirm[®], registered under a Section 18 exemption, provides good control. Bt is effective, but has a short residual, so multiple applications must be made. Timing of Bt applications is critical, as younger larvae are more susceptible. Pheromones for mating disruption are not widely used due to cost and limited levels of control. Lannate[®] or Dibrom[®] used for other pests will also control OLR. Dimethoate provides fair control and has long residual activity, but is not used very much because it disrupts beneficials.

Western grapeleaf skeletonizer (GLS) can be treated with granulosis viruses, which can provide fair to good natural control, but additional supplemental control via insecticides is usually required. Kryocide[®] provides good to excellent control. Bt is effective, but has a short residual, so multiple applications must be made. Timing of Bt applications is critical, as younger larvae are more susceptible. Lannate[®] or Dibrom[®] used for other pests will also control GLS.

Grape and vine mealybugs are controlled by Lorsban[®] applications used for ant control. Admire[®] gives good to excellent control when applied through drip irrigation systems, which provides better efficacy than use in furrow applications. Provado[®] provides fair control as a foliar applied material. Diazinon and Lorsban[®] provide fair to good control of mealybugs, depending on coverage. Imidan[®] gives only fair control of mealybugs. Lannate[®] provides control, but is very harsh on beneficials; coverage is critical for optimal efficacy with this product, and Lannate[®] has a shorter PHI than Admire[®]. Dimethoate provides only fair control of mealybugs and can also injure (mark) the grapes if applied late in season.

Natural and biological controls such as lacewings and *Cryptolaemus* beetles may be used; however, the level of predation and impacts on pest populations are not known.

Phylloxera can be treated with Admire[®] for good to excellent control when applied through drip irrigation systems. Enzone[®] provides fair to good efficacy, but overall performance of this product is quite variable, multiple applications are required, there are phytotoxicity concerns, and Enzone[®] is believed to disrupt soil biology.

Cultural controls to help manage *Phylloxera* problems include proper irrigation and nutrition to mitigate damage. Use of certain rootstocks may be beneficial.

Ants must be removed from the vineyard, as they are very disruptive to natural control of many pests. Clinch[®] and Esteem[®] baits work very well for ant control.

Citrus peel miner is a new pest in table grape vineyards; no biological or chemical controls are available for this pest.

Work Group Recommendations for Insect and Mite Management from Bud Break through Berry Development

RESEARCH	<ul style="list-style-type: none"> • Evaluate the effectiveness of granulosis viruses for GWSS • Evaluate Admire® performance in furrow applications • Evaluate the benefits of barley/vetch cover crops • Evaluate Platinum® for insect control • Evaluate citrus peel miner biology and effects on grapes • Conduct additional research to refine application techniques used for soil applied insecticides • Encourage continued research by registrants for new chemistries for all grape pests; new chemistries are needed for resistance management
REGULATORY	<ul style="list-style-type: none"> • Expedite Section 3 registration for Confirm® • Determine status of GWSS pheromone • Expedite registrations of Clinch® and Esteem® baits for ant control • Establish criteria for Section 18 and 24(c) registrations when alternatives are currently registered (e.g., resistance management)
EDUCATION	<ul style="list-style-type: none"> • Train growers, PCAs, and applicators on optimal plant and soil conditions to maximize product performance • Registrants should provide timely educational seminars/technology training on how to most effectively use products (especially for upcoming and new registrations) • Provide education to growers and PCAs on the use of economic thresholds, where available

WEEDS

Plowing and use of contact herbicides are the most common methods of weed control in season in vineyards not using cover crops. Light cultivation or mowing can be used in the areas between the rows (middles), but using this method of weed control in the vine row (berm) is impossible. Hand weeding is extremely labor intensive and costly.

At this time of year, contact herbicides such as Roundup® and Gramoxone® are effectively applied as spot sprays to control annual grasses, Johnsongrass, Bermuda grass, bindweed, and nutsedge. It is important to use shielded sprayers to avoid contact with grape foliage and minimize phytotoxicity. Goal® is not used in season due to phytotoxicity problems, but lower rates of Roundup® and Gramoxone® are used to control foliage height.

Work Group Recommendations for Weed Management from Bud Break through Berry Development

RESEARCH	<ul style="list-style-type: none"> Evaluate alternatives to Roundup® and Gramoxone®
REGULATORY	<ul style="list-style-type: none"> Obtain Section 3 registration for Prowl® on bearing vines Expedite Section 3 labels for Valor®, Milestone®, and Visor®
EDUCATION	<ul style="list-style-type: none"> Provide more Farm Advisors knowledgeable in weed science; they are greatly needed for local outreach and education Educate regulators on differences between wine grapes and table grapes in terms of weed management, economics, canopy development, profit margins, etc.

DISEASES

Several diseases that have been monitored throughout the dormant season may require a fungicide application at bud break. The primary diseases of concern during the spring months are powdery mildew, *Phomopsis*, black measles, Spanish measles, Pierce's disease, *Eutypa dieback*, *Botrytis*, sour rot, and viruses.

The single most important disease in California table grapes, powdery mildew causes yield loss and weakening of vines. The several fungicides available for control of powdery mildew are largely preventative in nature. Non-chemical controls include water management, canopy management, vector control, and use of resistant rootstocks and cultivars.

Powdery mildew may be controlled by leaf pulling – the removal of infected plant tissue to limit the spread of this disease. Canopy management to increase air flow will also reduce the severity of powdery mildew outbreaks. Additionally, use of models for disease forecasting has been extremely successful. Wettable sulfur provides excellent control of powdery mildew by creating a protective barrier between the pathogen and the leaf. Sulfur can be used with copper in early season if the temperatures are not greater than 90 degrees. However, sulfur in all forms must be used prior to disease incidence. Wettable sulfur is easier on predatory mites than dusting sulfur. Dusting sulfur provides excellent control of powdery mildew; however, required time intervals between applications must be complied with to ensure continued protection of vines. Drift issues with dusting sulfur are increasing; voluntary guidelines are in place. This product has a three-day PHI.

Several other fungicides providing good to excellent control of powdery mildew include Abound®, Rubigan®, Elevate®, Rally®, Procure®, and narrow range oil. Care must be taken to select a product which has an acceptable REI and/or PHI. In addition, some of these products are not cleared for use on table grapes which will be exported.

Phomopsis is particularly bad in wet years, but can be reduced by pruning out infected wood during dormancy. While captan provides excellent control of this disease, captan is classified as a B2 carcinogen, and is a focus of Proposition 65 and processor/trade issues. Dithane® and wettable sulfur/copper both provide good control of this disease, but sulfur combinations have a short residual and must be reapplied. Abound® provides good to excellent control and has a good residual, but is expensive.

Black measles, which is expressed during fruit set through harvest, has no known biological or chemical controls. The last known chemical control was cancelled in 1994.

Pierce's disease has no known biological or chemical controls. Weeds and alternate host plants near vineyards should be checked for the presence of the GWSS, an important vector of this disease.

Botrytis control is achieved with cultural practices including canopy management, bunch thinning, and good irrigation management. Models used as forecasting tools are very effective. Vanguard® provides good to excellent control of *Botrytis*; Elevate® and captan are good materials for this disease, although captan can be used only in early season and is the focus of several regulatory issues as previously mentioned. A spray or dusting of copper/sulfur provides fair to good control of *Botrytis*.

Sour rot control is obtained with canopy management, bunch thinning, and good irrigation management. Botran[®] efficacy for this disease is not known. A spray or dusting of copper/sulfur provides good control of sour rot if applied prior to bunch closing. Lime provides good control if timing is correct.

Viruses (leafroll, corky bark, Rupestris stem pitting, fanleaf) may be kept under control by using healthy and virus free plant materials. Controlling vectors such as mealy bugs and dagger nematodes also will help to reduce the severity of these diseases. Using sanitary techniques during pruning is very important to limit the spread of disease from one vine to another.

Work Group Recommendations for Disease Management from Bud Break through Berry Development

RESEARCH	<ul style="list-style-type: none"> • Conduct research on epidemiology and control of black measles and Spanish measles • Study ways to manage Pierce’s Disease (PD) • Evaluate viruses and virus management in Red Globe • Evaluate field levels of resistance/tolerance to <i>Botrytis</i>, powdery mildew, and Pierce’s Disease • Refine disease development models to allow more effective use by growers
REGULATORY	<ul style="list-style-type: none"> • Revisit issue of sulfur dust reentry intervals (REIs) from 1 to 3 days not matching calendar and temperature model • Expedite Section 3 registrations for grapes; don’t hold up new label for one crop issue • Expedite Topsin[®] M registration at US EPA (Cal/EPA has approved) • Expedite all Section 3 registrations (meet stated Agency timelines for new materials)
EDUCATION	<ul style="list-style-type: none"> • Educate users in English and Spanish on sulfur drift issues • Provide more detailed guidelines for powdery mildew control/drift management for table grapes • Encourage grower use and acceptance of disease models for improved management

NEMATODES

Nematode feeding and subsequent damage interferes with nutrient and water uptake, and nematodes may vector certain diseases. Maintaining good vine vigor through adequate irrigation and fertilizer management will help vines to partially overcome the effects of nematodes. Nematicides’ performance is affected by soil conditions and application procedures. Concerns about nematicides include township caps on the use of Telone[®] and the loss of Namacur[®] (fenamiphos) in 2005.

The most effective nematicide against root knot and dagger nematodes, Namacur[®] provides fair to good control; however, this product is scheduled for phase-out in 2005. Enzone[®] provides fair to good control of most nematodes in table grapes, and is most effective on ring nematode; but this product disrupts the soil environment and requires multiple applications to be effective. The efficacy of new products Oxycom[®] and DiTera[®] is not known at this time.

Work Group Recommendations for Nematode Management from Bud Break through Berry Development

RESEARCH	<ul style="list-style-type: none"> • Evaluate use of Oxycom[®] • Evaluate use of DiTera[®] • Evaluate effectiveness of nematode resistant rootstocks • Evaluate alternatives to replace Nematicur[®] • Determine the relationship between soil organic matter and the effects of nematodes
REGULATORY	<ul style="list-style-type: none"> • Expedite registration of new nematode controls
EDUCATION	<ul style="list-style-type: none"> • Educate EPA on lack of alternatives to Nematicur[®] and the impact this will have on the table grape industry

VERTEBRATE PESTS

Monitoring to determine whether gophers, ground squirrels, or voles are damaging plants or interfering with cultural activities must continue throughout the season. Owls can be encouraged to prey on gophers and voles by placing nesting boxes near vineyards. Shooting of ground squirrels is not allowed during the season.

Birds can significantly reduce crop yield and quality by feeding directly on the ripening fruit; monitoring birds when fruit starts to ripen is critical in knowing when to implement control measures. Bird damage may be lessened by use of sound devices, mylar tape, trapping, and shooting when crews are not in the vineyard.

There are no current work group recommendations for vertebrate management during bud break through berry development.

USE OF PLANT GROWTH REGULATORS (PGRs)

PGRs are important tools used for thinning fruit and increasing fruit size. PGR applications start at a prescribed time according to bloom, and are usually made at least twice during the early part of the season. As a thinning material, gibberellic acid (GA) is an excellent PGR; however, varietal responses differ. GA also works very well for increasing berry size, but care should be taken on colored varieties to not affect color and perhaps reduce fruitfulness the following season. Thus hand thinning is used in the Perlette variety of table grapes, but is not cost-effective on other varieties. CPPU (N-(2-chloro-4-pyridyl)-N-phenylurea) is under an experimental use permit (EUP) for application on specific varieties.

The reduced chilling hour requirements of the desert table grape growing regions leads vines to produce uneven bud break. Dormex[®] encourages a more even bud break, but caution must be used in locations near lemons to avoid phytotoxicity and defoliation.

Work Group Recommendations for Use of PGRs from Bud Break through Berry Development

RESEARCH	<ul style="list-style-type: none"> • Determine optimal CPPU rates and timing for all varieties • Evaluate other possible PGRs such as cytokinins
REGULATORY	<ul style="list-style-type: none"> • Allow larger EUP acreages on PGR trials • Don't change labels in middle of season
EDUCATION	<ul style="list-style-type: none"> • Educate regulators on the importance and use of PGRs in table grape management

HARVEST, STORAGE, AND POST- HARVEST (Summer - Fall)

Table grapes are harvested and packed by hand. Harvest begins in May in the Coachella Valley and extends from July through November in the San Joaquin Valley.

Harvest crews eliminate fruit not meeting quality standards. Harvested grapes are packed in the field into boxes, bags, or the container specified by the shipper. Fruit should be pre-cooled as soon as possible after removal from the field. The grapes are transported to a cooling facility, where they will remain until shipped. All fruit must be stored cold and within controlled humidity for quality control, but storage time and requirements will vary according to variety. For example, the Thompson seedless variety may be stored for up to 12 weeks.

DISEASES AND SPIDERS

The most important post-harvest disease of table grapes during storage and marketing is *Botrytis cinerea*. This fungus is introduced in the vineyard and is particularly problematical in years when late season rains occur. The primary commercial control of this disease is through fumigation and use of controlled atmosphere during storage. Sulfur dioxide provides good control of *Botrytis*. Recommended application rates must be followed to avoid discoloration and stem browning. Black widow spiders are now a concern of retailers and consumers. Efforts to learn more about this pest and how it can be prevented from contaminating product need to be evaluated.

Work Group Recommendations for Post-Harvest Disease Management

RESEARCH	<ul style="list-style-type: none">• Conduct research to improve post-harvest quality control measures• Develop management techniques for control of black widow spiders
REGULATORY	<ul style="list-style-type: none">• Expedite registrations of Elevate[®] and Scholar[®]• Expedite scald registrations in California (Sodium O-Phenylphenol - SOPP, ethoxyquin)
EDUCATION	<ul style="list-style-type: none">• Educate the public and regulators on the value of maintaining the use of SO₂

POST-HARVEST IN THE VINEYARD

(Fall)

After the fruit has been harvested, much work remains to prepare the vineyard for dormancy and the next growing season.

Cultural and Worker Activities

• Fertilization	• Scouting
• Irrigation	• Insecticide and nematicide applications
• Cover crops	• Pruning
• Cutting out blight	• Vineyard sanitation
• Diseased vine removal	

INSECTS

The most effective insecticide applications are often made during fall post-harvest because coverage is greater, or the pest is at its most vulnerable stage. Leucanium scale can be treated very effectively with oil if applications are made during the fall. Vine and grape mealybugs can be treated with Lannate® for fair to good control. Lorsban® also controls this pest.

Phylloxera can be controlled with Admire®, which has good efficacy against this insect. Enzone®,s efficacy is only fair, and soil moisture is critical for optimal performance.

Sevin® provides good control of GWSS but disrupts beneficials and may cause mite populations to flare up. Admire® provides excellent control for several months, but then its efficacy declines. Provado® provides good control of GWSS, but has a shorter residual than Admire®. Lannate®, Dibrom®, dimethoate, and Danitol® all provide good levels of control of GWSS. Lannate® and Dibrom®, however, have no residual activity. Surround®, kaolin clay used as a barrier, provides fair control of GWSS. This product can be applied up to bloom and post-harvest; it is also approved for use in organic vineyards. Pyrethrum provides fair control of GWSS and is organically approved.

Work Group Recommendations for Post-Harvest Insect Management

RESEARCH	<ul style="list-style-type: none">• Evaluate split applications of Admire® for insect control• Evaluate products and techniques to control black widow spiders
REGULATORY	<ul style="list-style-type: none">• Register products for black widow spider control
EDUCATION	<ul style="list-style-type: none">• Educate growers and packers on black widow spider control

WEEDS

Weed control during the post-harvest period in the vineyard includes use of residual herbicides and cultivation; Johnsongrass and Bermuda grass are best controlled at this time. Princep®, Karmex®, and Solicam® all work well, although there are state restrictions on the use of these herbicides. Surflan® is a good pre-emergence herbicide, although it is expensive and has limited availability. Generic oryzalin has become available and is registered.

The “French plow” is not widely used for row plowing because it can damage irrigation drip lines and the vines’ root systems. The French plow system also is expensive and uses a great deal of fuel due to requiring multiple passes throughout the vineyard.

The work group recommendations for this time of the year are the same as those indicated for the dormant period.

DISEASES

Some diseases need to be evaluated during post-harvest in the vineyard to determine whether controls will be needed during the dormant season. Diseases which are symptomatic now are powdery mildew, *Phomopsis*, Pierce's disease, black measles, and *Eutypa dieback*. The primary diseases to evaluate at this time are powdery mildew and black measles; appropriate measures should have been taken during dormancy or early spring for these diseases (as previously discussed). For some diseases, treatments will need to be made according to weather conditions or according to plant development in spring.

The work group recommendations for this time of the year are the same as previously discussed.

NEMATODES

Monitoring should continue throughout the fall season to determine the densities of nematodes infesting vineyard soils. Nemacur[®], the most effective nematicide on root knot and dagger nematodes, provides fair to good control, but is scheduled for phase-out in 2005. Enzone[®] provides fair to good control of most nematodes in table grapes, and is most effective on ring nematode; however, this product disrupts the soil environment and requires multiple applications to be effective. The efficacy of DiTera[®] is not known at this time.

There are no current work group recommendations for nematode management during post-harvest in the vineyard.

VERTEBRATE PESTS

Monitoring for gophers, ground squirrels, and voles continues during this season. Owl predation on gophers and voles can be encouraged by placing nesting boxes near vineyards. Baits and traps can be used, and shooting is allowed at this time of the year.

There are no current work group recommendations for vertebrate management during the fall.

IR-4 PROJECT NEEDS

IR-4 provides the vital link to the process of registering new crop protection chemicals for table grapes. The following products are needed by the table grape industry in California. Adequate baseline data on efficacy are needed to initiate the process. A pesticide clearance request (PCR) form will need to be submitted for each product/use combination to the Western Regional Office at UC Davis prior to the annual Food Use Workshop held each September.

Work Group Recommendations for IR-4 Needs

RESEARCH	<ul style="list-style-type: none"> • Evaluate Esteem® bait for ant control
REGULATORY	<ul style="list-style-type: none"> • Register Esteem® bait for ant control • Register a pre-emergence nutsedge product such as Authority® or Shadeout® • Register Platinum® for GWSS control • Register Applaud® for mealybug control

INTERNATIONAL ISSUES

Significant quantities of California table grapes are shipped to international markets, primarily Canada, China/Hong Kong, Malaysia, and Mexico. It is important that U.S. registrations are harmonized with the regulations of the importing countries.

Work Group Recommendations for International Issues

RESEARCH	<ul style="list-style-type: none"> • Encourage registrants to develop residue data and export tolerances for new products prior to U.S. registration
REGULATORY	<ul style="list-style-type: none"> • Develop/maintain an approved list of materials that can be used on table grapes; request that FDA maintain a current log of international registrations • Encourage registrants to establish export tolerances for new products prior to registration • Harmonize registrations between the US EPA and importing countries
EDUCATION	<ul style="list-style-type: none"> • Commodity groups should regularly educate growers and PCAs as to materials which are approved by export countries • Educate and encourage registrants to develop tolerances in compliance with foreign markets prior to full U.S. registration • Harmonize EPA registration requirements with the MRL and Codex systems used in other countries • Encourage EPA and FAS to work with Codex to expedite international registrations so that newer and safer products may be used in the U.S. without fear of trade irritant issues

3. CRITICAL ISSUES FOR THE CALIFORNIA TABLE GRAPE INDUSTRY

The following items were identified by the Table Grape Work Group as being the most critical to the sustained viability of the California table grape industry.

<p>RESEARCH</p>	<ul style="list-style-type: none"> • Develop pest control techniques that are effective, economical, and environmentally sound • Develop resistance management strategies for insecticides and miticides (especially new neonicotinoid products) • Develop biologically-based pest control products and techniques • Study the biology and management of black measles, Spanish measles, black widow spider • Identify post-emergence herbicides that do not damage vines • Evaluate methyl bromide alternatives • Expand information on the relationship between improved soil and plant health as it relates to the ability of the vines to withstand pest pressures
<p>REGULATORY</p>	<ul style="list-style-type: none"> • Expedite registrations of products to control vine mealybugs, sharpshooters and black widow spiders • Expedite registrations of pre-plant fumigants and nematicides • Expedite registrations of pre-emergence and post-emergence herbicides • Maintain availability and use of methyl bromide until proven alternatives (economic and technical) are in place through Critical Use Exemptions (CUEs) or quarantine pre-shipments (QPS) as needed • Obtain an exemption for quarantine pre-shipment (QPS) use of methyl bromide • Resolve export issues concerning quarantine and market access • Establish Codex MRLs early in the product registration phase for new chemicals registered in the U.S.
<p>EDUCATION</p>	<ul style="list-style-type: none"> • Educate regulators regarding the intensive efforts that growers are making to manage vine health and vigor to help alleviate pest susceptibility and damage • Continue to educate growers, PCAs, and PCOs on safe and efficient applications techniques • Continue to educate growers, PCAs, workers, and the public on sulfur drift mitigation • Remind the public through effective media messages that the consumption of fresh fruits and vegetables, particularly table grapes, contributes to a nutritious diet and healthy lifestyle

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The Harmonized Tariff Schedule of the United States (2002). United States International Trade Commission.
<http://dataweb.usitc.gov/scripts/tariff/toc.html>

California Department of Pesticide Regulation (CDPR) Pesticide Use Reports.
<http://www.cdpr.ca.gov/dprdatabase.htm>

Crop Profile for Grapes (Table) in California.
<http://pestdata.ncsu.edu/cropprofiles/docs/cagrapes-table.html>

APPENDICES

1. 2002 California Table Grape Production Statistics

County	Bearing and Non-bearing Acres
Fresno	11,545
Kern	33,770
Kings	838
Madera	3,030
Riverside	10,658
Tulare	26,799
Thompson Seedless for Table Use*	29,000
State Totals	115,640

Source: California Agricultural Statistics Service (CASS)

*Thompson Seedless grapes are grown for raisin, table, and wine use in California. CASS reports all Thompson Seedless acreage under raisin grapes. The table grape industry estimates ~29,000 of those acres are for table use.

2. Table Grape Crop Development, Cultural Practices, and Pest Management Activities

Southern San Joaquin Valley

Crop Development	J	F	M	A	M	J	J	A	S	O	N	D
Dormancy	■	■										■
Bud Break			■									
Rapid Shoot Growth				■	■							
Bloom					■	■						
Fruit Development					■	■	■	■				
Harvest						■	■	■	■	■	■	
Post-Harvest							■	■	■	■	■	■
Storage of Table Grapes	■								■	■	■	■
Cultural Practices	J	F	M	A	M	J	J	A	S	O	N	D
Cultivation	■	■	■	■	■	■	■	■	■	■	■	■
Irrigation		■	■	■	■	■	■	■	■	■	■	
Pruning	■	■									■	■
Thinning				■	■	■						
Frost Protection		■	■									
Girdling					■	■						
Fertilizer Application	■	■	■	■	■	■	■	■	■	■	■	■
Plant Cover Crop										■	■	
Shoot Removal				■	■							
Cluster and Berry Thinning				■	■							
Fruit Exposure (for color)						■	■	■	■			
Pest Management Activities	J	F	M	A	M	J	J	A	S	O	N	D
Soil Sampling	■	■	■	■	■	■	■	■	■	■	■	■
Scouting	■	■	■	■	■	■	■	■	■	■	■	■
Insecticide Applications		■	■	■	■	■	■	■	■	■	■	
Dormant Insecticide Applications	■	■										■
Fungicide Applications			■	■	■	■	■	■	■			
Residual Herbicide Applications	■	■	■									■
Contact Herbicide Applications	■	■	■	■	■	■	■	■	■	■	■	■
Plowing for Weed Control	■	■	■	■	■	■	■	■	■	■	■	■
Nematicide Applications				■	■	■	■	■	■	■	■	
Vertebrate Control	■	■	■	■	■	■	■	■	■	■	■	■
Plant Growth Regulators Applied					■	■	■	■				
Monitor Border Crops (e.g., GWSS)	■	■										■

Data based on collective field observations and experiments; timings for table grape production in the Coachella Valley are approximately five to seven weeks earlier than in the San Joaquin Valley

3. Seasonal Pest Occurrence in California Table Grapes

Southern San Joaquin Valley

INSECTS/MITES	J	F	M	A	M	J	J	A	S	O	N	D
Leafhoppers - Variegated												
Leafhoppers - Grape												
Mealybugs												
Spider Mites												
Thrips												
Omnivorous Leaf Roller												
Glassy-Winged Sharpshooter												
Western Grapeleaf Skeletonizer												
Cutworms												
Grape Leaf roller												
DISEASES	J	F	M	A	M	J	J	A	S	O	N	D
Powdery Mildew												
<i>Botrytis</i> Bunch Rot												
<i>Phomopsis</i> Cane / Leafspot												
Measles												
Eutypa												
Pierce's Disease												
Downy Mildew												
WEEDS	J	F	M	A	M	J	J	A	S	O	N	D
Johnsongrass												
Bermuda Grass												
Annual Grasses												
Mustards												
Nutsedge												
NEMATODES	J	F	M	A	M	J	J	A	S	O	N	D
Root Knot												
Dagger												
VERTEBRATES	J	F	M	A	M	J	J	A	S	O	N	D
Rabbits												
Voies												
Gophers												
Ground Squirrels												
Birds												

Data based on collective field observations and experiments; timings for table grape production in the Coachella Valley are approximately five to seven weeks earlier than in the San Joaquin Valley

4. Efficacy of Insecticides and Miticides

Chemical Pesticides

Efficacy Ratings: E=Excellent, G=Good, F=Fair, P=Poor-to-None, R=Known Resistance, - = No Information

PRODUCTS	TRADE NAMES	Leafhoppers	Mealybugs	Spider Mites	Thrips	Omnivorous Leaf roller	Phylloxera	GW Sharpshooters	W. Grapeleaf Skeletonizer	Cutworms	Grape Leaf Roller	False Chinch Bug	Grape Bud Beetle
Azinphos-methyl	Guthion [®]	P	P	P	F	G	-	-	G	-	F	-	G
<i>B. thuringiensis</i>	Bt - various	P	P	P	P	F	P	P	G	F	F	P	P
Carbaryl	Sevin [®]	F	P	P	F	F	P	-	F	G	F	F	F
Carbofuran	Furadan [®]	-	-	P	P	P	F	P	P	P	P	P	P
Chlorpyrifos	Lorsban [®]	P	E	P	P	P	P	P	P	P	P	P	P
Cinnamaldehyde	Valero [®]	P	N	P-F	P	P	P	P	P	P	P	P	P
Cryolite	Kryocide [®]	P	P	P	P	G	P	P	G	P-F	G	P	-
Diazinon	various	F	F	P	P-F	F	-	F	F	F	F	F	F
Dicofol	Kelthane [®]	P	P	F	P	P	P	P	P	P	P	P	P
Dimethoate	Cygon [®]	G	F-G	P	F	P	P	F	P	P	P	F	P
Endosulfan	Thiodan [®]	F-G	P	P	P	P	P	P	P	P	P	P	P
Fenamiphos	Nemacur [®]	P	P	P	P	P	F	P	P	P	P	P	P
Fenbutatin-oxide	Vendex [®]	P	P	G	P	P	P	P	P	P	P	P	P
Imidacloprid	Provado [®] , Admire [®]	E	G	P	-	P	P	E	P	P	P	F	P
Malathion	various	F	F	P	P-F	P	P	F	P	P	P	F	P
Methomyl	Lannate [®]	E	F	P	G	G	P	G	G	F	G	F	F
<i>Myrothecium verrucaria</i>	DiTera [®]	P	P	P	P	P	P	P	P	P	P	P	P
Naled	Dibrom [®]	G	F	P	F	-	-	F	F	P	P	F	P
Narrow Range Oil	various	F	P	F	P	P	P	P	P	P	P	P	P
Neem Oil	Trilogy [®]	F	P	P	P	P	P	P	P	P	P	P	P
OLR Pheromone	Checkmate [®]	P	P	P	P	G	P	P	P	P	P	P	P
Phosmet	Imidan [®]	P	F-G	P	F	G	P	F	G	G	G	P	G
Piperonyl butoxide	PBO	P	P	P	P	P	P	P	P	P	P	P	P
Potash Soap	M-Pede [®]	P	P	P	P	P	P	P	P	P	P	P	P
Propargite	Omite [®]	F	P	G	P	P	P	P	P	P	P	P	P
Pyrethrins	various	F	P	P	F	P	P	-	P	P	P	P	P
Sodium Tetrathiocarbonate	Enzone [®]	P	P	P	P	P	F	P	P	P	P	P	P
Sulfur	various	P	P	P	P	P	P	P	P	P	P	P	P

Data based on collective field observations and experiments

5. Efficacy of Non-Chemical Insect Management Practices

Efficacy Ratings: E=Excellent, G=Good, F=Fair, P=Poor-to-None, R=Known Resistance

NON-CHEMICAL PRACTICES	Leafhoppers	Mealybugs	Spider Mites	Thrips	Omnivorous Leaf Roller	Phylloxera	Sharpshooters	W. Grapeleaf Skeletonizer	Cutworms	Grape Leaf Roller	False Chinch Bug	Grape Bud Beetle	Ants
Cover Crops		G	P	P	P	P	P	P	P	P	P	P	G
Habitat Management	P	P	P	E	G	N	F	P	F	P	E	P	G
Monitoring/Use of Action Thresholds	G	F	G	P	P	P	P	P	P	P	P	P	P
Natural Enemies	G	G	G	P	F	P	P	G	P	F	P	P	P
Nutrition	P	P	P	P	P	P	P	P	P	P	P	P	P
Sanitation	P	P	P	P	F	P	P	P	P	P	P	P	P
Soil/dust Management	P	P	G	P	P	P	P	P	P	P	P	P	P
Use of Models	P	P	P	P	G	P	P	P	P	P	P	P	P
Resistant Varieties	P	P	P	P	P	G	P	P	P	P	P	P	P
Water Management	P-F	P	G-E	P	P	P	P	P	P	P	P	P	E
Weed Control	P	P	P-F	G	G	P	F	P	P	P	P	P	G
Mulching	P	P	P	P	P	P	P	P	P	P	P	P	P
Trap Crops	P	P	P	P	P	P	P	P	P	P		P	P
Netting	P	P	P	P	P	P	P	P	P	P	P	P	P
Pheromones (mating disruption)	P	G	P	P	G	P	P	P	F-G	P	P	P	P
Pheromones (population monitoring)	P	G	P	P	G	P	P	G	F-G	G	P	P	P

Data based on collective field observations and experiments

6. Relative Impact of Insecticides and Miticides on Beneficial Organisms

Relative Toxicity/Impacts: H = high, M = moderate , L = low , — = no information

COMMON NAME (Trade Name)	SELECTIVITY (Targeted Insect Groups)	Western Predatory Mite (<i>Galendromus occidentalis</i>)	General Predators	Parasites
Abamectin (Agri-Mek [®])	moderate (mites, leafminers)	H	L	M-H
<i>Bacillus thuringiensis</i>	narrow (caterpillars)	L	L	L
Bifenazate (Acramite [®])	narrow (mites)	—	—	—
Carbaryl (Sevin [®]) dust	broad (insects, mites)	L-H	H	H
Carbaryl (Sevin [®]) 80S	broad (insects, mites)	L-H	H	H
Carbofuran (Furadan [®]) soil app.	broad (soil organisms)	L	L	L
Chlorpyrifos (Lorsban [®])	broad (insects, mites)	M	H	H
Cryolite (Kryocide [®])	narrow (foliage chewing insects)	L	L	L
Diazinon-foliar	broad (insects, mites)	L	H	H
Dicofol (Kelthane [®])	narrow (pest mites and mites)	H	M	M
Dimethoate	broad (insects, mites)	H	H	H
Endosulfan (Thiodan [®])	broad (insects, mites)	L	M	M
Fenbutatin Oxide (Vendex [®])	narrow (pest mites)	L	L	L
Hexythiazox (Savey [®])	narrow (mites)	L	L	L
Imidacloprid (Admire [®])	—	—	—	—
Imidacloprid (Provado [®])	narrow (sucking insects)	—	—	H
Insecticidal Soap (M-Pede [®])	broad (insects, mites)	M	M	M
Kaolin Clay (Surround [®])	—	—	—	—
Malathion	broad (insects, mites)	H	H	H
Methomyl (Lannate [®])	broad (insects, mites)	H	H	H
Naled (Dibrom [®])	—	—	—	—
Neem Oil (Trilogy [®])	broad (soft-bodied insects)	L	L	L
Petroleum Oil	broad (exposed insects, mites)	L	L	L
Phosmet (Imidan [®])	broad (insects, mites)	H	H	H
Propargite (Omite [®])	narrow (pest mites)	M	L	L
Pyridaben (Pyramite [®] , Nexter [®])	broad (insects, mites)	—	—	—
Sodium tetra-thiocarbonate (Enzone [®])	broad (soil organisms)	L	L	L
Sulfur	narrow (mites, citrus thrips)	L-H	L	H

Data source: UC IPM Pest Management Guidelines: Grape, UC ANR Publication 3448

Note: toxicities are averages and should be used only as a general guide; actual toxicity depends on species, environmental conditions, and application rate

7. Efficacy of Disease Management Tools

Efficacy Ratings: E=Excellent, G=Good, F=Fair, P=Poor-to-None, R=Known Resistance

FUNGICIDE	TRADE NAME	Powdery Mildew	Botrytis Bunch Rot	Summer Bunch Rot	Phomopsis Cane / Leafspot	Measles	Eutypa & Canker Diseases	Pierce's Disease	Downy Mildew	Crown Gall
Chemical										
<i>Ampelomyces Quisqualis</i>	AQ 10	F	P	P	P	P	P	P	P	P
Azoxystrobin	Abound [®]	E	F	P	P	P	P	P	P	P
Captan	various	P	G	G	E	P	P	P	P	P
Copper Hydroxide	various	G	F	F	P	P	P	P	G	P
Copper Sulfate (Basic)	Bordeaux [®]	G	F	F	P	P	P	P	G	P
Copper/Sulfur Dust	various	E	P	G	P	P	P	P	P	P
Cyprodinil	Vanguard [®]	F	E	G	P	P	P	P	P	P
Dicloran (DCNA)	Botran [®]	P	G	G	P	P	P	P	P	P
Fenarimol	Rubigan [®]	E	P	P	P	P	P	P	P	P
Fenhexamid	Elevate [®]	G	E	G	P	P	P	P	P	P
Iprodione	Rovral [®]	P	E	G	P	P	P	P	P	P
Mancozeb	Dithane [®]	P	F	F	G	P	P	P	F	P
Maneb	various	P	F	F	G	P	P	P	P	P
Mefenoxam	Ridomil [®] Gold	P	P	P	P	P	P	P	E	P
Myclobutanil	Rally [®]	E	P-F	P	P	P	P	G	P	P
Narrow Range Oil	various	E	G	G	P	P	P	P	P	P
Potassium Bicarbonate	Kaligreen [®]	G	P	P	P	P	P	P	P	P
Sulfur	various	E	P	P	P	P	P	P	P	P
Triadimefon	Bayleton [®]	F	P	P	P	P	P	P	P	P
Trichoderma	Trichodex [®]	P	P	P	P	P	P	P	P	P
Triflumizole	Procure [®]	E	P	P	P	P	P	P	P	P
Ziram	various	P	F	F	G	P	P	P	P	P
Non-chemical										
Models (disease forecasting)		E	G	P	P	P	P	P	P	P
Irrigation Management		P	P	P	P	P	P	P	P	P
Weed Control		P	P	P	P	P	P	P	P	P
Resistant Varieties		G	P	P	P	P	P	P	P	P
Cover Crops		P	P	P	P	P	P	P	P	P
Adjusted Planting Date		P	P	P	P	P	P	P	P	P
Adjusted Harvest Date		P	P	P	P	P	P	P	P	P
Fertilizer Management		F	P	P	P	P	P	P	P	P
Vector Control		P	P	P	P	P	P	F-G	P	P
Biological Control		F	F	P	P	P	P	P	P	P

Data based on collective field observations and experiments

8. Efficacy of Nematode Management Tools

Efficacy Ratings: E=Excellent, G=Good, F=Fair, P=Poor-to-None, R=Known Resistance, - = No Information

PRODUCT	TRADE NAME	Root Knot Nematode	Ring Nematode	Dagger Nematode	Root Lesion Nematode	Citrus Nematode
Chemical						
1,3-Dichloropropene	Telone II [®]	F-E	F-E	F-E	F-E	F-E
Mycotoxin	DiTera [®] , post-plant only	F	F	F	F	F
Metam-sodium	Vapam [®]	P-E	P-E	P-E	P-E	P-E
Methyl Bromide	MB-98	F-E	F-E	F-E	F-E	F-E
Sodium Tetrathiocarbonate	Enzone [®] , post-plant only	P-F	F-G	F-G	P-F	F-G
Phenamiphos	Nemacur [®] , post-plant only	F-G	F	F	G	F-G
Non-Chemical						
Rootstocks	Harmony [®] /Freedom [®]	E/10yr	-	G	-	-

Data based on collective field observations and experiments

Note: product performance is strongly influenced by soil conditions at time of application

9. Efficacy of Weed Management Tools

Efficacy Ratings: E=Excellent, G=Good, F=Fair, P=Poor-to-None, R=Known Resistance

HERBICIDE	TRADE NAME	Nightshade	Mallow	Pigweed	Russian Thistle	Purslane	Mustard	Johnson Grass	Bermudagrass	Fields Bindweed	Nutsedge	Annual Grasses
Chemical												
2,4-D	Envy [®]	E	F	E	G	G	E	P	P	F	P	P
Dichlobenil	Casoron [®]	E	E	F	G	G	E	P	P	P	G	P
Diuron	Karmex [®]	E	P	E	E	E	E	G	G	P	P	G
Fluazifop Butyl	Fusilade [®]	P	P	P	P	P	P	E	E	P	P	E
Glyphosate	Roundup [®]	E	F	E	G	E	E	G	G	F	G	E
Napropamide	Devrinol [®]	P	P	E	G	G	F	G	G	P	P	G
Norflurazon	Solicam [®]	E	F	F	G	G	F	G	G	P	F	E
Oryzalin	Surflan [®]	P	P	E	F	G	P	G	G	P	P	E
Oxyfluorfen	Goal [®]	E	E	E	F	G	E	P	P	P	P	P
Paraquat Dichloride	Gramoxone [®]	E	P	E	G	E	E	P	P	P	P	P
Pendimethalin	Prowl [®]	P	P	E	P	E	P	F	F	P	P	E
Sethoxydim	Poast [®]	P	P	P	P	P	P	G	G	P	P	E
Simazine	Princep [®]	E	F	E	E	E	E	F	P	F	P	F
Soap (salts)	Scythe [®]	F	F	F	F	P	F	P	P	P	P	P
Trifluralin	Treflan [®]	P	P	E	P	E	P	F	F	F	P	E
Non-Chemical												
Cultivation		E	F	F	E	E	F	P	P	P	P	F
Soil/Water Management		P	P	P	P	P	P	P	P	P	G	P
Cover Crops		G	F	G	E	E	G	G	F	P	F	G
Subsurface Drip Irrigation		G	G	G	G	G	G	P	P	P	P	G
Hand Weeding		E	F	E	E	E	E	P	P	P	P	G

Data based on collective field observations and experiments

10. Efficacy of Vertebrate Pest Management Tools

Efficacy Ratings: E=Excellent, G=Good, F=Fair, P=Poor-to-None, R=Known Resistance, - = No Information

PRODUCT	TRADE NAME	Birds	California Ground Squirrel	Pocket Gopher	Meadow Vole	Deer	Coyote	Jackrabbit
Chemical								
Diphacinone	Ramik [®] , Promar [®]	-	G	P-F	G	-	-	P
Chlorophacinone	Rozol [®]	-	G	P-F	G	-	-	P
Strychnine	various baits and poisons	-	-	F	-	-	-	-
Zinc Phosphide	Phosvin [®]	-	G	P	G	-	-	-
Aluminum phosphide	Phostoxin [®]	-	G	F-G	-	-	-	-
Gas cartridges	various	-	G	P	-	-	P	-
Repellents	various	-	P	P	P	F	P	F
Non-Chemical								
Exclusion		E	P	F	P	E	G	E
Predators		P	P	P	P	P	P	P
Cultural Barriers (e.g., trap crops)		P	P	P	P	P	P	P
Cultural Control (e.g., cover crop management)		P	P	F	G	P	P	-
Trapping		F	G	G	P	-	F	P
Shooting		P	F	-	-	P-F	F	F
Hazing Techniques		P-F	P	P	P	P	P	P
Trained Predators (e.g., falcons, guard dogs)		P-F	-	-	-	-	F	-

Data based on collective field observations and experiments

11. Efficacy of Post-Harvest Insect and Disease Management Tools

Efficacy Ratings: E=Excellent, G=Good, F=Fair, P=Poor-to-None, R=Known Resistance

PRODUCT	TRADE NAME	DISEASE
		<i>Botrytis</i>
Sulfur dioxide	various	G-E

Data based on collective field observations and experiments

12. Efficacy of Plant Growth Regulators (PGRs)

Efficacy Ratings: E=Excellent, G=Good, F=Fair, P=Poor-to-None, R=Known Resistance

PRODUCT	TRADE NAME	EFFICACY
Ethephon	Ethrel [®]	G
Gibberellic Acid	Megagro [®] , etc.	E
Hydrogen Cyanamide	Dormex [®] , etc.	G

Data based on collective field observations and experiments

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