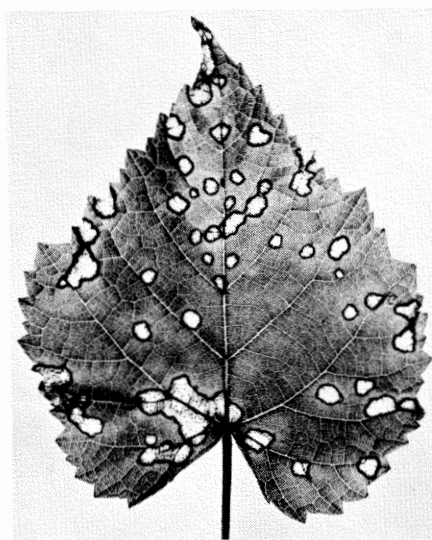


# Diseases of Grapes

## and Their Control in Virginia



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# Grape Diseases and Their Control in Virginia

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## Introduction

Viticulture tradition is nearly as old as that of human culture and is probably intermingled with it. According to some ancient writings, viticulture and wine-making in Egypt go back 5,000 to 6,000 years. Grape seeds found in the remains of the Swiss Lake dwellings of the Bronze age and in prehistoric Egyptian tombs closely resemble seeds of species extensively cultivated today. Grapes are grown everywhere in the world where the environment is reasonably favorable. About 23 million acres of grapes are grown in 39 countries of the world and economically are the most important of all the fruit crops.

Diseases have been largely responsible for limiting the area of commercial grape production in certain areas. Black rot was primarily the cause of the abandonment of large acreages in Virginia during the early 1900's. Downy mildew, powdery mildew, anthracnose, and dead arm have caused extensive losses in some localities.

Generally, grape diseases are harder to control in those localities with prevailing high temperatures, high humidity, abundant rainfall, and longer growing season. The weather conditions greatly influence the occurrence and severity of the diseases, even within a locality. Consequently, the danger always exists that diseases which normally cause only minor loss may develop into an epiphytotic under the right environmental conditions.

The selection of a vineyard site with adequate air drainage is highly important in reducing the possibility of serious disease losses. The removal of diseased parts of the vine at the time of pruning and general vineyard sanitation make attempts to control disease more effective. Practices that make conditions less favorable for the development of the overwintering stages and spore dissemination may be considered as measures to supplement the recommended spray program.

In vineyards where disease losses are apt to be serious when no spraying is done, the benefits from properly applied treatments are greater than their cost. If the losses are sporadic and minor, however, it is doubtful whether the expense of the full schedule of treatments is returned through increased yield. The decision to apply control measures depends on a knowledge of the history of disease losses in a particular locality. For example, in some localities grape diseases are so easily controlled that in some years 1 or 2 applications of a fungicide are sufficient, whereas in other years the general spray schedule is hardly adequate.

A general knowledge of the causal organism, and the means by which it overwinters will aid the viticulturist in controlling diseases. Correct identification of diseases is essential for the intelligent use of control measures. This publication

describes the symptoms and cause of the major grape diseases. Thus, the grower may become more familiar with grape diseases and the proper control procedures.

## Control Practices

Controlling grape diseases is based on prevention rather than on curative measures. One can usually prevent further spread of a disease by applying the recommended fungicide after the symptoms are visible on the foliage but the infected berries and vines cannot be cured. Thus, a well-planned protective spray program initiated before infection is the best assurance of healthy vines and berries. When applying pesticides to grapes, use a clean sprayer and only the recommended dosage. If possible, spray when conditions are favorable for rapid drying, and be sure to obtain complete coverage of berries and vines. All users of pesticides should read and be familiar with the keys to proper use of pesticides. For fungicide selection, time of application, and the recommended dosage see Virginia Cooperative Extension Service Publication 33.

The general spray schedule for grape disease control Virginia Cooperative Extension Publication 33 is not a bound part of this bulletin. It is an insert that will be revised annually. For simplicity, there is a separate schedule for home-owners and commercial viticulturists.

**PREVENTION OF GRAPE DISEASES:** Home-owners growing only a few grapes for home consumption can produce disease-free fruit without spraying, by slipping ordinary paper bags over the cluster immediately after the blossoms fall. Three-to-five-pound paper bags are suitable. Tie the mouth of the bag securely around the stem of the cluster, or fold the bag over the vine above the cluster so that you can pin the corners or fasten them with paper clips. A small hole should be made in the lower corner of the bag to permit drainage.

## Grape Diseases

### Black Rot

Black rot is a widespread disease of grapes, and it probably causes greater loss to growers in Virginia than all other diseases combined. This disease is caused by a fungus, Guignardia bidwellii, that attacks the leaves, shoots, tendrils, canes, blossoms, and fruit. Only the youngest tissues are susceptible, although the fruit may become infected until it is almost fully grown. Rotting of fruit after it begins to color is generally caused by other fungi.

Usually about 2 weeks elapse between the time of infection and the appearance of symptoms. The foliage infections appear in the spring as tiny, more or less circular spots. They are reddish-brown and are usually encircled by a yellow ring. Through the coalescence of many spots, large areas of the leaf may become affected. Small black fruiting-bodies of the fungus are formed in the lesions (Figure 1). Although spotting occurs on the foliage in the spring, the disease does not attract much attention until mid-summer, when the nearly half grown grapes begin to rot.



Figure 1. Black rot infection on leaf. The lesions are distinctive and contain fruiting bodies of the fungus.

The disease on the fruit first appears as light-brownish, soft, circular spots, which enlarge rapidly, and after a few days the entire berry is discolored. Within a short time small black pimples (fungus fruiting-bodies) appear on the discolored berry. The decaying berries soon begin to shrivel, and within a week they are transformed into black, hard, shriveled mummies, which may remain attached to the bunch for several weeks (Figure 2). The attached mummied fruit is covered with small fruiting bodies of the black rot fungus that exude infective spores during moist wet weather to start new infections on susceptible parts of the vines.



Figure 2. Black rot infection on grape cluster. Note mummied berries.

The fungus remains semi-dormant in the mummies during the winter, but during warm, moist weather in the spring forms new spores called ascospores, which infect the young leaves and shoots. Thus, the causal organism is perpetuated from one season to the next. There is some evidence that the rot organism can overwinter in the lesions on canes, tendrils or other plant parts. The abundance of the disease from season to season depends on the weather conditions during the spring and early summer, and the amount of diseased material carried over from the previous season on the mummies and plant residue.

## Control

**Cultural Practices:** Grapevines are ordinarily pruned each year during the dormant period. In the pruning process the mummies that may have remained attached are removed or shelled off. Also, many of the old infected canes are pruned off and removed from the vineyard. This practice has aided greatly in black rot control. It has been found that the mummies do not produce spores when covered with soil. Thus, cultivation of the vineyard early in the spring is advocated where practical.

**Spraying:** Black rot can be effectively prevented with 6 to 8 applications of a good fungicide.

## Downy Mildew

Downy mildew is a fungus disease, primarily of the grape foliage. If the disease occurs early in the season, however, the young bunches of berries may be entirely killed by the attack of the stem as well as of the young fruit. The causal fungus, Plasmopara viticola, is widespread in nature.

The fungus overwinters in the old leaves on the ground. Weathering and decomposition liberate the spores. When they have been subjected to freezing temperatures, they germinate during a rainy period to form swarm spores that are carried by the spattering rain to the lower leaves where they may cause primary infection. After the fungus has become established, abundant spores are formed on the lesion and the disease may then spread throughout the vineyard.

The first evidence of the disease on the leaves appears as light-yellow spots on the upper surface of the oldest leaves in the center of the vine. Later a white moldy growth of the fungus mycelial threads and spores form on the under surface of the leaves (Figure 3). The fungus spreads from the older foliage to the foliage at the end of the canes as the leaves mature. By autumn highly susceptible varieties are completely defoliated and the clusters of

fruit may be scalded by the sun. Also, vines defoliated before the ripening season cannot mature the fruit normally and the fruit is of inferior quality.



Figure 3. Downy mildew of grape on lower side of the leaf.

#### Control

**Sanitation:** Cultural practices are of major importance in the control of this disease. Since primary infection results from the oospores that are in the old leaves, removal or plowing under of the leaves and keeping the canes as high above the ground as practical reduces the chances of primary infection. Proper pruning and spacing of the vines to obtain good air movement, which results in rapid drying, reduces the chances of secondary spread.

**Spraying:** Downy mildew is comparatively easy to control with a good fungicide program.

#### Powdery Mildew

Powdery mildew is caused by a fungus known as *Uncinula necator*. It is present in many vineyards, but it is of little economic importance in Virginia. The fungus primarily attacks the foliage and cluster stems; it appears on the berries only in unusually favorable seasons. Unlike black rot and downy mildew, this disease is favored by periods of low rainfall and only moderately high relative humidity (between 70 and 80%).

The fungus overwinters in brownish-black fruiting-bodies, called perithecia, that are formed on the infected plant parts. Ascospores are released from the fruiting-bodies in the spring and may cause primary infection on the upper part of the leaves and on other green parts of the vines.

Powdery mildew infection appears as a superficial, grayish-white growth on the infected parts of the vine (Figure 4). Severely affected leaves turn brown and defoliation occurs. If the berries are infected, the surface appears russet or scurfy (Figure 5). They fail to mature properly, but no rot is associated with the injury. Infection of the cluster stem may cause shelling if the fruit is not harvested immediately.

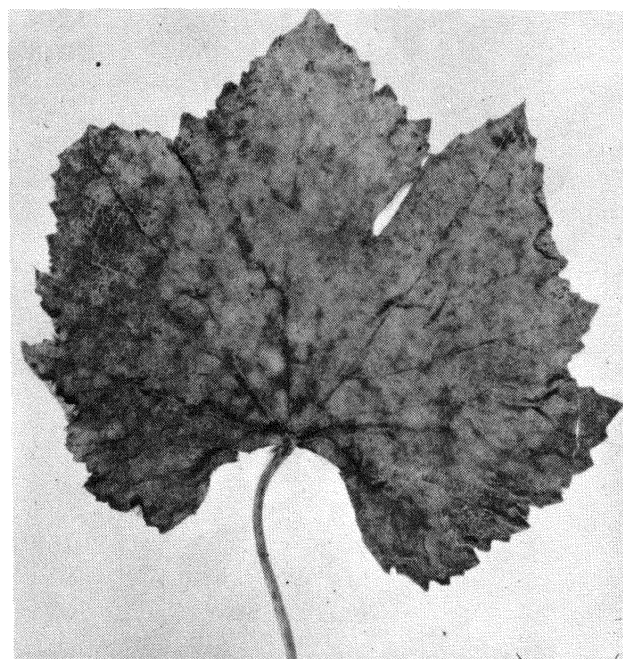


Figure 4. Powdery mildew of grape. Note the upper surface of the leaf is almost covered with the white, powdery, superficial growth of the fungus.

#### Control

**Sanitation:** Cultural practices are important in the control of powdery mildew. Rapid drying of vines following dews and rains reduces the chance of infection. Therefore, an effort should be made to train the developing shoots in such a way as to reduce shading and allow air circulation. Destruction of infected parts of the vines during the winter and spring will reduce the amount of primary inoculum, but will not eliminate the disease.



Spraying: Powdery mildew is usually absent in vineyards sprayed to prevent black rot and downy mildew.

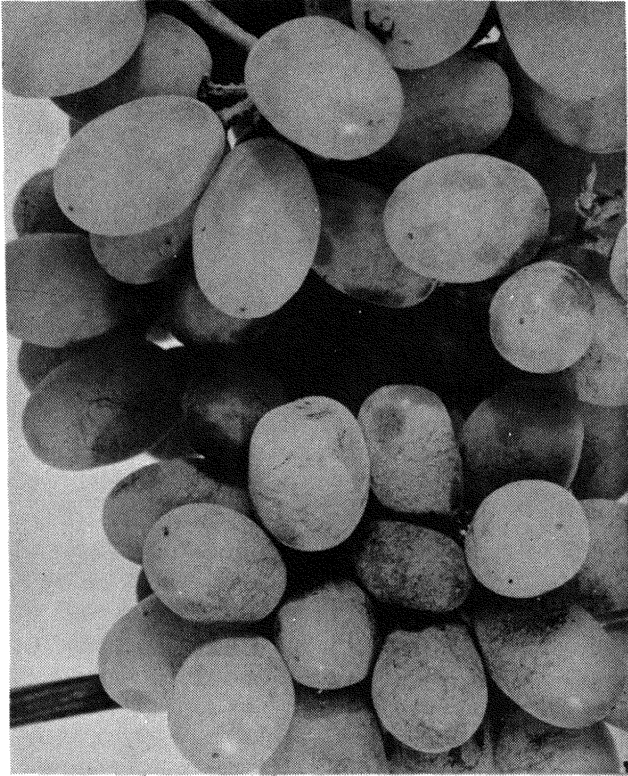


Figure 5. Powdery mildew on the berries of grapes. The surface of the fruit appears russet or scurfy.

### Anthracnose or Bird's-Eye Rot

This disease is sporadic in nature and its occurrence is usually localized. It is caused by the fungus Elsinoe ampelina. The disease may do considerable damage in a vineyard or locality for a few years, then disappear. There is considerable variation in varieties susceptible to the causal fungus.

The fungus overwinters in the infected canes and gives rise to infective spores during the spring. The spores are washed onto the developing green tissue where they germinate and penetrate the unwounded shoots. The fruit, young shoots, tendrils, petioles, leaf veins, and fruit stems may be attacked severely.

Numerous spots sometimes occur on the young shoots. Some spots will unite and cause girdling. Similar spots develop on the petioles and leaves. Badly infected

leaves curl downward from the margins, becoming distorted and spotted, and the diseased areas drop out so that the leaf appears ragged.

On the fruit the spots are circular, sunken, and ashy gray. In the late stages of the disease the spots are surrounded by a dark margin. The name of "bird's-eye rot," sometimes applied to this disease, is derived from the appearance of the spots on the berries (Figure 6).

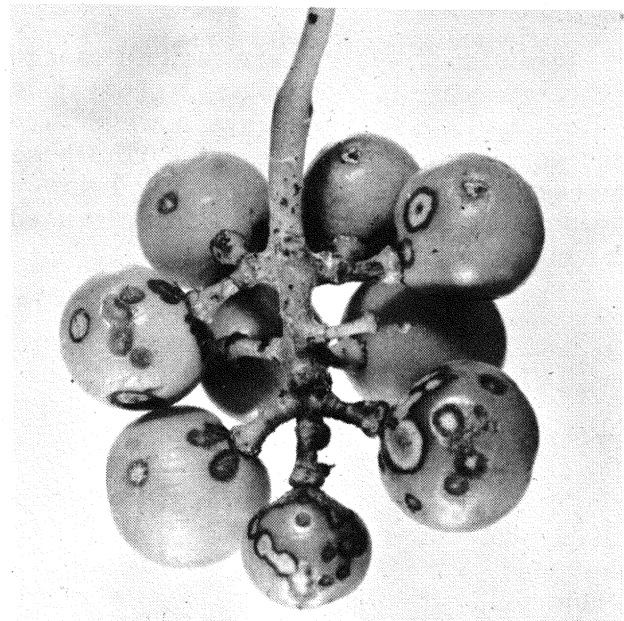


Figure 6. Grape Anthracnose on berries and fruit stem. The lesions or spots have the appearance of a "bird's-eye."

### Control

Sanitation: Remove and burn all infected parts as far as practical. In localities where Anthracnose is a serious problem a new vineyard should be planted to resistant varieties such as Concord, Delaware, Niagara, etc.

Spraying: Prevention of Anthracnose can be obtained with a properly carried out fungicide program.

### Bitter Rot and Ripe Rot

Bitter rot, caused by the fungus Melanconium fuligineum, and ripe rot, caused by the fungus Glomerella cingulata, are often mistaken for black rot by inexperi-

enced growers. These diseases develop as the berries approach maturity. Bitter rot and ripe rot do not cause a shriveling of the berries like black rot and they usually occur much later in the growing season. There are no characteristic symptoms to distinguish between bitter and ripe rot except the causal fungus of bitter rot causes a bitter taste to grape pulp contaminated with the rotted berries.

### Control

Bitter and ripe rot are insignificant in vineyards where a good fungicide program is followed. Late season sprays, however, are necessary to protect the berries from these diseases as well as black rot and downy mildew. Use the same spray program used for black rot.

### Dead Arm

**DEAD ARM:** Dead arm is primarily a disease of the trunk and main branches of the vine and is caused by the fungus *Phomopsis viticola*. The fungus can attack young shoots, fruit stems, and occasionally berries. The fungus overwinters in the infected tissue and produces spores during May and June to cause new infections.

The most easily recognized symptom is the dead arm (branch) on the vine. This is observed in the spring when the vine either fails to put out shoots or the shoots die back after a few weeks. In June or early July the young branches or shoots on the diseased arm are stunted and have shortened internodes which become progressively shortened and stunted from year to year. The primary leaves are about half the size of normal leaves and are misshapen. Badly lesioned vines are weakened and usually die during the dormant period.

Early symptoms occur in June and are frequently masked by secondary growth that occurs from axillary buds in early July. The new growth, however, usually dies by late July or August.

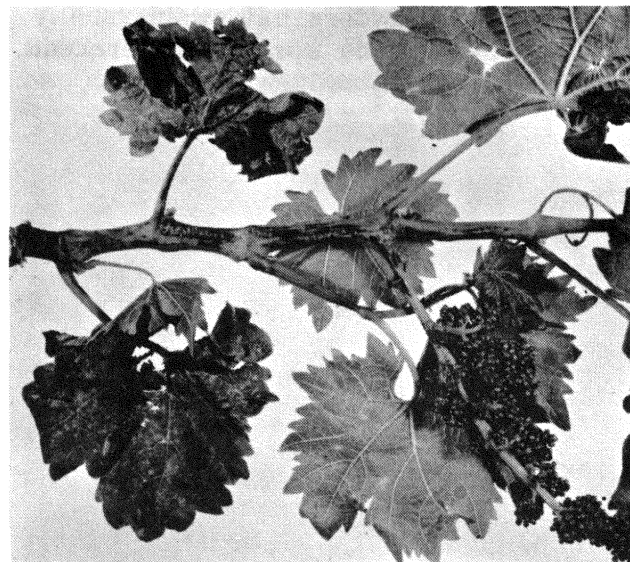


Figure 7. Dead arm of grape showing lesions on the shoot, petioles, and fruit stem. Also note distortion of some of the leaves.

The disease occurs on new cane growth as small purple to black sunken lesions on the first 3 or 4 internodes (Figure 7). These lesions may also occur on the leaf petioles or fruiting stems (Figure 8). The necrotic lesions can be seen under the bark of older canes and trunk tissue. Cross-sections through the discolored lesions reveal a V-shaped, discolored area extending into the pith. The lesion stage on the trunk may exist 2 to 3 years before leaf symptoms appear. The ultimate confirmation of the disease is the presence of numerous small, black pycnidia (fungus fruiting structures) on the surface of the wood under the bark.

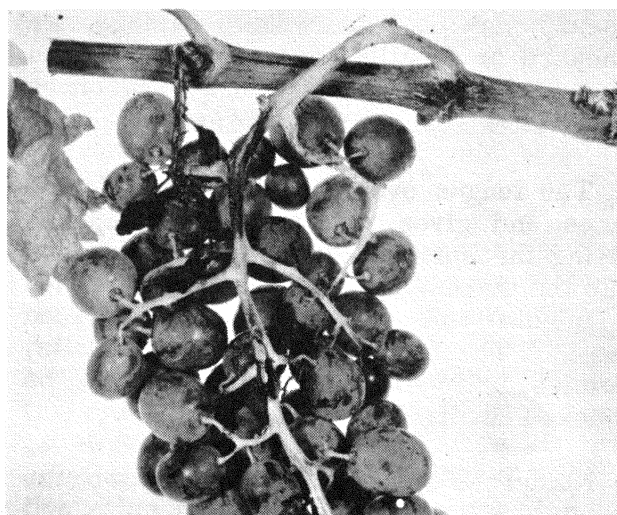


Figure 8. Dead arm of grape with infection lesions on the fruit stem.



## Control

**Sanitation:** Remove the diseased parts of the vine well below the margins of the canker and burn them as soon as they are found. This will aid in reducing the disease.

**Spraying:** Protect the pruning wounds during May and June with a good fungicide program. The protection program for black rot will usually control dead arm.

## Crown Gall

Crown gall is usually not a serious disease in Virginia, but it is conspicuous on the vines when it occurs. It is caused by a bacterium, *Agrobacterium tumefaciens*, usually considered to be a wound parasite of the roots, canes, and trunk. When the roots are affected, large, more or less spherical galls develop, usually near the ground line (Figure 9).

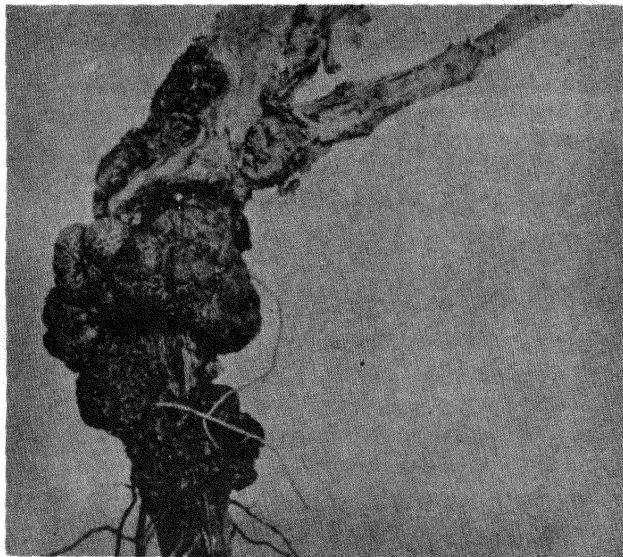


Figure 9. Crown gall of grape.

## Control

The causal bacterium lives in the soil; thus, it cannot be controlled by spraying. Examine new plants before planting, and discard any that have galls. Large galls that are present on the upper parts of the trunk or on the arms can be removed by pruning the arm or trunk below the affected tissue and renewing the vine by means of a shoot from the base of the vine.

## Virus Diseases

A number of viruses infect the grape vine. Fanleaf, Yellow Mosaic, Pierce's Disease, and White Emperor do extensive damage in many areas. These diseases have not been reported in Virginia. There is no cure. Selecting vines and buds free of the disease is the best method of preventing spread of these diseases.

## Grape Diseases Incited by Nematodes

The economic importance of nematode diseases on grapes has not been established in Virginia. Root knot and the root lesion nematode cause serious losses to grapes in California. Resistant varieties seem to be the answer if nematodes become troublesome to Virginia growers.

## Nonparasitic Disorder

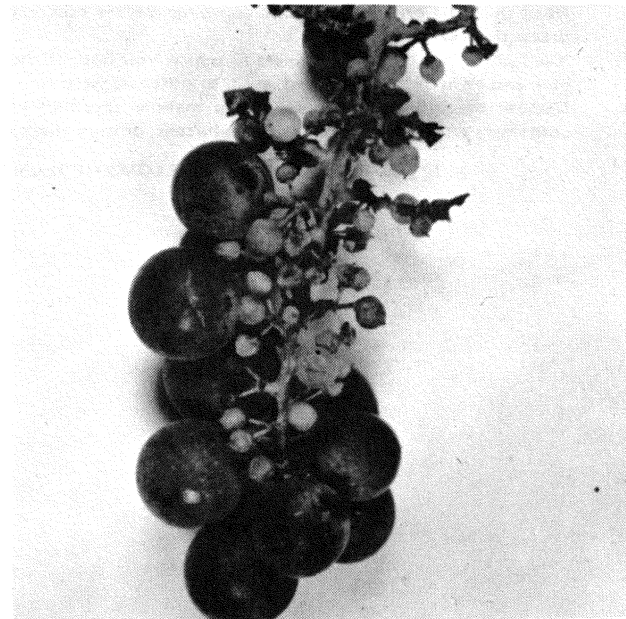


Figure 10. Shot berries of grape. Note the small berries intermingled with normal berries.

## Shot Berries

Infrequently, home-owners or commercial viticulturists are confronted with small, round, green, seedless grapes intermingled with normal berries in a cluster (Figure 10). Flowers that fail to develop

into berries usually drop from the cluster within a week or so after opening. Frequently, flowers that might drop remain attached to the cluster and develop into small, round, seedless berries (called shot berries or the French speak of them as "millerandage") instead of normal berries.

The failure of flowers to develop into normal berries may be caused by poor pollination or fertilization, defective flower parts, poor carbohydrate nutrition of flower before bloom, or even a virus disease. The malady is primarily of concern rather than of an economic loss under Virginia conditions.

Trade and brand names are used only for the purpose of information and the Virginia Cooperative Extension Service does not guarantee nor warrant the standard of the product, nor does it imply approval of the product to the exclusion of others which may also be suitable.

#### KEYS TO PROPER USE OF PESTICIDES

1. Read the label on each pesticide container before each use. Follow instructions to the letter; heed all cautions and warnings, and note precautions about residues.
2. Keep pesticides in the containers in which you bought them. Put them where children or animals cannot get to them, preferably under lock and away from food, feed, seed, or other material that may become harmful if contaminated.
3. Dispose of empty containers in the manner specified on the label. If disposal instructions are not printed on the label, burn the containers where smoke will not be a hazard, or bury them at least 18" deep in a place where water supplies will not be contaminated.

SEE YOUR DOCTOR IF SYMPTOMS OF ILLNESS OCCUR DURING OR AFTER USE OF PESTICIDES.