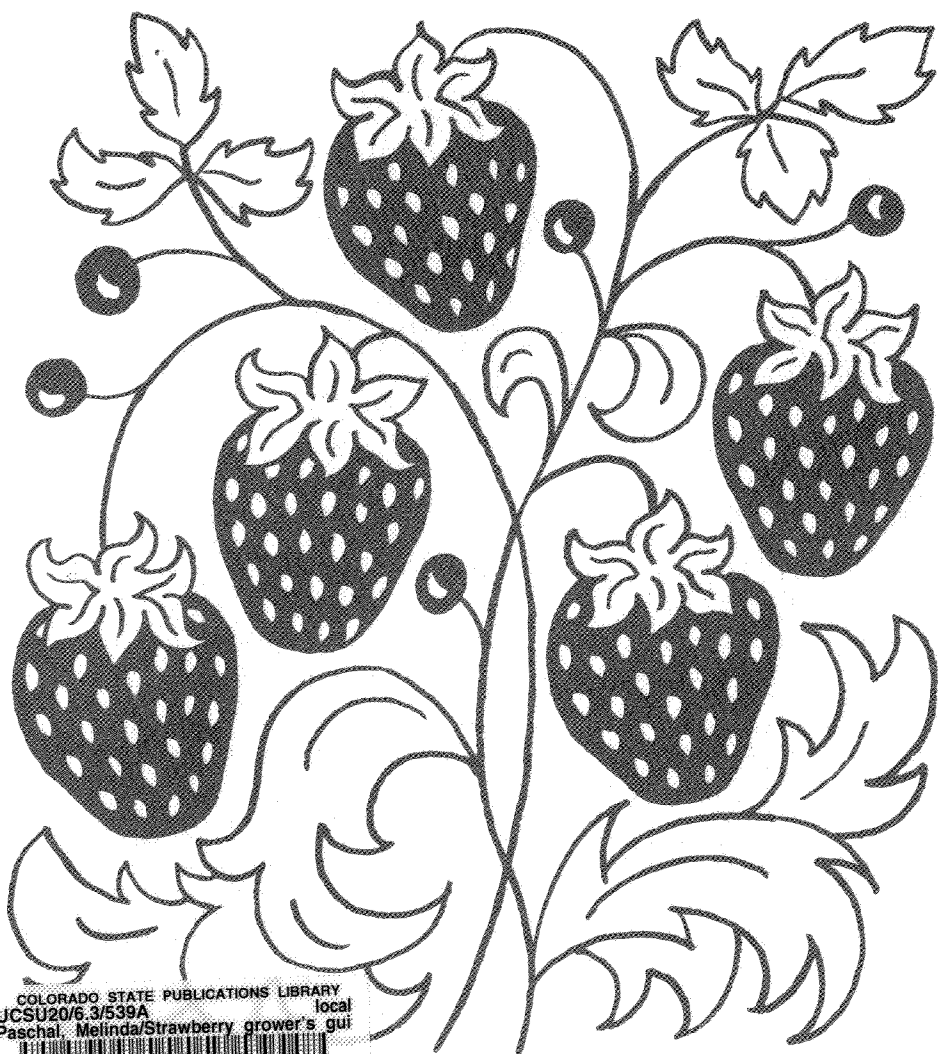


UCSU 20/618/539A

# STRAWBERRY GROWERS GUIDE

Colorado  
State  
Univ  
Coop  
Ext

Bulletin 539A



COLORADO STATE PUBLICATIONS LIBRARY  
UCSU20/6.3/539A local  
Paschal, Melinda/Strawberry grower's gui



Issued in furtherance of Cooperative Extension work, Acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture, Kenneth R. Bolen, director of Cooperative Extension, Colorado State University, Fort Collins, Colorado. Cooperative Extension programs are available to all without discrimination. To simplify technical terminology, trade names of products and equipment occasionally will be used. No endorsement of products named is intended nor is criticism implied of products not mentioned.

Strawberry Grower's Guide  
Bulletin 539A

by

Melinda Paschal  
Harrison Hughes,  
Richard Renquist<sup>1</sup>

---

<sup>1</sup>Former student, and associate professors, department of horticulture.

The information presented herein is a summary of general knowledge with regards to strawberry as well as observations and research by the authors on strawberries growing in Colorado. Funding was provided by the Colorado Agricultural Experiment Station (Project 604), Colorado Horticulture Research, Inc., and Colorado State University Cooperative Extension.

The authors wish to acknowledge the technical assistance of Linda and Virgil Esensee in the preparation of the figures. They also thank Drs. James Ells, Harold Larsen and Kenneth Yu, associate professors in horticulture for their comments and assistance in the preparation of this grower's guide.

## Introduction

Strawberries have long been a popular fruit for use, fresh and prepared in jams and pies. They are widely adapted and grown throughout the United States. At one time, hundreds of acres were grown commercially in Colorado, however, high labor costs of production and harvesting resulted in a decline in the late 1940's. This decline was a common phenomenon in much of the United States.

In the past 25 years there has been a renewed interest in strawberries, especially pick-your-own (PYO) operations. Many states east of the Mississippi River now have a viable strawberry industry built around the consumer picking the fruit. This benefits both the consumer who gets high quality fresh fruit and recreation and the grower whose labor costs are reduced.

With the present population increase in the front range, a viable PYO operation may be feasible in Colorado. Anticipating this, Colorado State University has evaluated the potential of new cultivars for Colorado production.

An understanding of growth and fruiting characteristics of the cultivated strawberry, *Fragaria x ananassa*, is basic to production of the fruit. It is a herbaceous perennial plant with a reduced stem area that forms a basal crown (Figure 1). The plant spreads naturally by runners, which root at every other node, and by crown division.

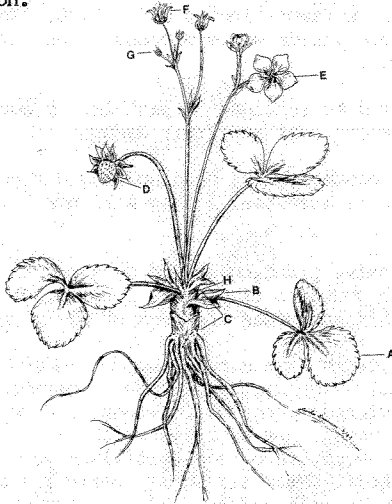


Figure 1. Flowering strawberry plant. A. Oldest leaf; B. Leaf stipule; C. Crown; D. Primary fruit; E. Secondary flower; F. Tertiary flowers; G. Quaternary flowers; H. Growing point in leaf axil.

Cultivars can be classified into three groups according to flowering characteristics: Junebearers, everbearers, and day neutrals.

Junebearers are most commonly grown for commercial production. They flower and fruit in the spring. Flowers are initiated in the fall, when temperatures

are cool and days are short, and overwinter in the crown. Runner production typically occurs when days are longer and temperatures are warmer. Cultivars recommended for strawberry production in Colorado include Kent, Honeoye, Guardian, Midway, Delite and Shuksan. These cultivars have the most concentrated yield in a short period of time and are recommended for commercial production.

Everbearers are more commonly grown by the homeowner. They typically fruit heavily in the spring and again during the latter part of the summer and early fall. Their total yield is generally smaller than the Junebearers. Fort Laramie, Ogallala and Quinalt are the recommended cultivars.

Day neutrals are similar to everbearers and most generally sold as such. However, they tend to fruit more often over a longer period of time. Most day neutrals are susceptible to iron chlorosis. Tribute, Sakuma, Hecker, Tristar and Fern are recommended varieties.

### **Site**

One of the most important factors in strawberry production is proper selection of a growing site. Soil, exposure, drainage, land contour and slope, and previous crops are all factors influencing appropriate site selection.

Strawberries can grow in soils ranging from light sand to heavy clay, but the ideal soil texture is a sandy loam with 3 percent to 5 percent organic matter. Optimum soil pH for strawberries is 6.5 to 6.8. Soils with a pH above this have produced reasonable yields where micronutrient (iron and sometimes zinc) fertility was adequate.

A location fully exposed to sunlight is best for strawberry production with adequate wind breaks to prevent leaf and fruit damage.

Strawberries require adequate water availability during the growing season although good drainage also is essential. They will not tolerate water-logged conditions.

Where slopes are excessive planting should be along the contour of the land to prevent soil erosion. A southern slope will lead to earlier flowering and fruit ripening; however, this increases the risk of frost damage in early spring.

Knowledge of previous crops on a site being considered for strawberries is very important in successful strawberry production. Strawberries should not be planted in soils where eggplants, peppers, potatoes, tomatoes or raspberries have grown within the past four years, nor on sites which previously were cherry orchards. These crops are susceptible to verticillium wilt and other fungal diseases which infest the soil. Most strawberry varieties are susceptible to this disease and when infected wilt and die. Crop rotation with grains and legumes is recommended because these reduce the incidence of nematodes and root rot fungi.

### **Soil Preparation and Planting**

To prepare land for the next year's strawberry crop, it is best to plow under a green manure crop. This adds organic matter to the soil and reduces weeds. A moderate (one inch deep) application of manure prior to sowing the

green crop also improves soil structure.

Land used for strawberry production should be plowed seven (17.5 cm) to eight (20 cm) inches deep. When the soil is dry enough to plant the area should be disked and harrowed to break up clods. This also makes plant setting much easier.

Planting is done in spring after likelihood of severe frost has passed. Two methods of planting are employed in strawberry production. The method used is dependent on what cultivar is planted, the type of irrigation available and salinity of the soil.

In the matted row system plants are placed 1 to 2 feet (30 to 60 cm) apart in rows 4 feet (120 cm) apart. Plants produce runners to fill in the rows. A pathway 18 inches (45 cm) wide is maintained between the rows by removing runners. The matted row system is used with Junebearers and works best with a well drained soil or where salinity poses a problem.

In poorly drained soils a raised bed system is used. Plants are set in single or multiple rows 14 to 16 inches (35 to 45 cm) apart, on 6-inch (15 cm) high beds. Both raised beds and matted rows can be kept for three years.

Special care should be taken to set plants carefully. The crown should be just above the soil level (Figure 2). If plants are set too low the crowns will rot. Leaving the tops of roots exposed is even more serious since root drying reduces survival.

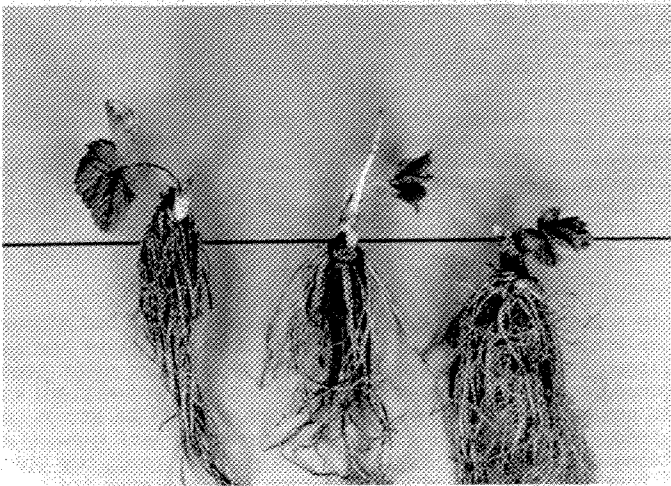


Figure 2. Planting depth of strawberry. The left is planted too shallow, the right too deep with the center at the correct depth.

It is best to use dormant virus-free certified plants obtained from a

reputable nursery. They should be planted during the cooler part of the day to reduce wilting and as soon after arrival as possible to increase survival. Unhealthy plants or plants with dark roots are discarded.

Many larger commercial operations are using mechanical transplanters. This speeds the rate of planting considerably. Plantings set at low densities in the matted row system should have their flowers removed the first year. This encourages greater growth of the mother plant and larger numbers of runners.

### **Mulching**

Mulching helps conserve water, produces clean fruit free of soil, prevents erosion and root damage due to alternate freezing and thawing, and most importantly provides winter protection.

Although other materials may be used, straw is usually used. It is a good insulator and does not mat down over the plants when wet cutting off the air supply. A straw mulch should be applied about December 1, after sufficient cold weather to inhibit growth. Straw is placed over plants to an approximate depth of 2 inches (5 cm) and may be held in place with piles of soil or weighted boards if the rows are exposed to excessive wind. A shelter belt is recommended to reduce loss of mulch due to wind. Use clean or old straw to reduce subsequent growth of seeds. A pre-emergence herbicide is recommended to reduce seed germination. See the current Cooperative Extension Publication, Colorado Small Fruits - XCM-49, for available materials, rates and methods.

In March, plants should be checked for new growth. When new growth occurs, the mulch should be raked away from the plants slightly to allow sunlight to reach the foliage. As growth continues mulch is gradually removed; however, as much mulch as possible is left to keep the fruit off the ground.

### **Fertility**

Additional preplant fertilization is not usually necessary if strawberries are planted following a green manure crop. However, a side dressing of nitrogen is recommended at four to six weeks after planting. Nitrogen can also be applied in mid-August to increase the number of flower buds formed during late summer and early fall. A well fertilized soil, however, will not require nitrogen at this time.

Renovation is a useful post harvest procedure to maintain bed vigour. It keeps plants in an active stage of growth by mowing the old leaves and narrowing the row with tillage prior to fertilization. The procedure is often preceded by two weeks of imposed drought, during which time selective weed killers may be used. One should use caution in amounts of nitrogen applied as excess quantities of nitrogen can reduce the number of flowers, cause excess leaf growth, and softening or rotting of the fruit. To determine fertility needs one should always do a soil test prior to the planting season. Once plants are established leaf tissue analysis may be done.

Iron deficiency is common in the high pH soils typical of the front range and Grand Valley. The best remedy is selection of chlorosis resistant cultivars, but application of either foliar applied iron sulfate or the more expensive but longer lasting soil applied iron chelates are useful. The iron chelate form Fe

EDDHA (or Fe 138) is the only form of iron which remains stable at soil pH values over 7.2; its high cost requires precise placement near chlorotic plants or through a drip irrigation system if the whole planting is iron deficient. Early spring or at renovation are the most useful times of application.

### **Irrigation**

Adequate water must be available during the growing season as soil moisture availability significantly affects fruit size and yield. Inadequate soil moisture decreases fruit size and yield whereas excessive soil moisture leaches essential nutrients during the fruiting season, encourages fruit softening and rotting. In arid regions strawberries may need water every three days if the soil is sandy and four to five days if the soil is heavy. They require approximately 1.5 inches (3.8 cm) of water per week from May through September.

Three basic types of irrigation systems can be employed in strawberry production. Drip systems consist of plastic tubing containing small holes or special emitters as water outlets. They can be placed on the surface of the soil next to the plant or buried. Both placements require an adequate filter system to prevent clogging. Although drip systems are quite efficient in water usage, they are also expensive on plantings less than two acres. They can be used on raised beds or flat ground.

Solid set or movable sprinkler systems are used in strawberry production on flat ground. Although they can be costly and do not use water as efficiently as drip systems, they do offer protection against frost. When used for frost protection, sprinkling should begin before the temperature reaches 32° F (0° C) and continue until the ice starts to melt. As the water freezes heat is given off to the plants. This maintains plant tissue (flowers) at or near 32° F. thus minimizing freeze damage.

Conventional furrow irrigation can be used with raised beds. In alkaline soils; however, care must be taken as water moves through the soil it carries salts along the front edge of the water. If irrigation is ended with that front in the vicinity of plants, toxic levels of salt accumulate as water evaporates from the surface. As with sprinkler systems, furrow irrigation makes harvest, especially PYO, more difficult due to muddy soil conditions.

### **Harvesting**

During the peak of the fruiting season, strawberries should be picked every other day. Even the rotted fruit should be picked to prevent any further infestation of the crop. Berries which are to be consumed immediately should be picked when red ripe with caps intact. If the fruit is to be marketed commercially berries should be picked when they're light red in color. The proper color varies with variety. Grading and sorting should be done while harvesting to reduce handling.

### **Weed Control**

Because strawberries have a shallow root system, they are especially vulnerable to weed competition. Weeds compete for light, water, and nutrients and thereby limit plant growth, flowering and fruit set. Perennial weeds such as field bindweed represent the single greatest production challenge for strawberry



growing in Colorado.

Fumigation, crop rotation, cultivation, mulches and herbicide application are all methods commonly used for control. Herbicides must be used with extreme caution; however, pre-season control of bindweed is recommended (see publication XCM-49 for details).

### Diseases and Insects

Diseases affecting strawberries in Colorado include: red stele, yellows, verticillium wilt, black root rot complex, leaf spot, and leaf scorch. The only fruit disease to date is botrytis (grey mold or fruit rot) and is rare on the western slope.

Red stele is a root rot disease common in heavy soils but can be a problem in sandy soils if plants are overwatered. Symptoms identifying the disease are a distinctive brownish red in the center (stele) of the root and frequent wilting of the plants. Reduction in overwatering often controls red stele somewhat, even with susceptible cultivars. Presently there are no chemical methods which will assure a normal crop in an infected field. Resistant varieties with good fruit quality are available and should be selected.

Yellows are a group of viral and mycoplasma diseases that dwarf plants and produce leaves with dull green centers and yellow edges. Control requires removal of diseased plants and rotation of strawberries with other crops. Insecticidal sprays control aphids which transmit these diseases.

The fungus which causes verticillium wilt is most active in cool moist weather. Symptoms appear in new plantings at the time runners begin to form. In established plantings, symptoms appear when fruit begins to ripen. Symptoms include wilting of outer leaves and drying at margins and between veins. New leaf growth is inhibited and new roots growing from the crown are very short with blackened tips. Severely affected plants collapse abruptly. In western areas infected plants usually do not recover. Control of verticillium wilt is very limited, thus prevention of this disease is important. It can be prevented by not growing strawberries on land which has previously been planted to tomatoes, peppers, potatoes, eggplants, or any other member of the solanaceae family. Other plants which may lead to verticillium wilt problems include sweet cherries, roses, raspberries, and melons. Overwatering increases the incidence of the disease. Fumigation of the soil with chloropicrin can provide good control but is very costly.

Although not a major problem in Colorado, botrytis (grey mold or fruit rot) should be mentioned as it can occur as a result of overwatering with sprinklers. The disease is favored by shady, moist conditions. It affects blossoms, blossom stalks and the fruit. Control can be achieved by proper timing of fungicidal sprays, controlled watering and prompt removal of infected plants.

Black root rot is a general name assigned to a group of problems associated with the roots which produce similar symptoms. Although the cause of black root rot is not known, soil fungi, nematodes, winter injury, fertilizer burn, drought and too much water, salt or alkali are believed to be partly responsible. Symptoms of black root-rot are as follows: a small root system, main root spotted with dark patches, and feeder roots not present or also spotted with dark

patches. To date no control methods for this disease can be recommended. Proper watering and the selection of soils with adequate drainage and good aeration will reduce the incidence of the disease.

Insect damage of strawberries in Colorado is minimal. Grasshoppers can be controlled by use of an insecticidal bait. Aphids and mites generally do not directly damage strawberry plants but serve as vectors for transmission of virus diseases. Control can be accomplished by use of insecticidal sprays and powders. Complete coverage of the plants by the insecticide is essential for effective control. Slugs can be a problem under moist conditions but can be controlled by use of slug bait. Consult publication XCM-49 for specific recommendations for insect control.

### Marketing and Pick-your-own (PYO) Operations

Marketing is of utmost importance in order to be successful and maximize profits. It is especially significant in PYO operations.

There are 10 important points which should be considered in order to run a successful PYO operation: 1) planning, 2) consistent quality production, 3) advertising, 4) parking, 5) liability insurance, 6) supervision, 7) public relations, 8) knowledge of production costs, 9) patience, and 10) profit. Planning involves things such as advance purchasing of plant materials and supplies and locating necessary labor. If fruit is sold by weight, scales must be checked and licensed by the State Department of Agriculture. For information on scale licensing contact the following office: Colorado Department of Agriculture, Weights and Measures Section, 2331 West 31st Avenue, Denver, CO 80211, (303) 839-2845.

Composing a yearly checklist of items to be accomplished before planting, harvest, etc., can help insure that tasks are done when necessary and aid in organization of the operation.

From the growers standpoint success is based upon consistent high yields of quality fruit. High yields are dependent on production practices such as selection of the best varieties for the particular growing area, good pest and weed control, efficient use of water and fertilizer, and successful winter protection.

Making the public aware of your enterprise is important in building clientele. Publicity can take many forms such as newspaper ads and local radio announcements. The best methods to use are dependent on the location and forms of mass media available within the area. Mailing a card to previous customers a few weeks prior to harvest is very effective. A mailing list can be made by having customers fill out a card with their name and address at the check out stand. Directions to the farm should be included with all publicity.

Adequate off street parking must be provided for your customers. One acre of parking to every five acres of strawberries will give you adequate space. Many growers use cut hayfields as temporary lots during the harvest season. To avoid congestion there should only be one entrance and one exit. Easy to read signs and temporary fencing can help direct traffic. Parking guides can also be helpful in speeding traffic flow. The parking area should be located behind the check out stand.

Protection provided by an adequate liability insurance plan is a must in a PYO operation. The North American Strawberry Grower's Association (NASGA) provides special policies for growers. Coverage can be obtained for just the harvest period. The NASGA can be contacted at: Edward and Betty Burns, Executive Secretaries, NASGA, Route 1, Box 313, Madrid, NY 13660.

Many accidents can be prevented by using common sense. Don't leave machinery within the vicinity of the field. If you set a minimum age for picking, you should provide a supervised play area for younger children.

A few field supervisors present during picking can be helpful to keep people in the proper rows, etc. School teachers are generally available during the harvest season, are experienced in dealing with people and make good field supervisors. Rules should be posted in brief simple language and politely enforced. The use of a brochure describing rules, picking instructions and other information is appropriate. A portable public address system is also helpful in larger operations.

Knowing how to handle your employees and customers is of utmost importance in running a smooth operation. You should also become acquainted with your local county and state extension offices.

In order to establish a fair price for your crop know your production costs. If you sell your strawberries by weight instead of volume you can eliminate many price disagreements with your customers.

Dealing with crowds of customers on a daily basis can be very taxing on one's nerves. Patience is a must to maintain good customer relations. Good planning can eliminate uncomfortable situations.

Profit is important to the grower in order to stay in business. Returns can be increased by strictly following proven production practices.

**Sources of Plant Material**

Ahren's Strawberry Nursery  
R.R. 1  
Huntingburg, ID 47542

Allen Co.  
P.O. Box 1577  
Salisbury, MD 21801

Nourse Farms  
B485  
Deerfield, MA 01373

Lewis Strawberry Nursery  
P.O. Box 24  
Rocky Point, NC 28457

Makielski Berry Farm and Nursery  
7130 Platt Road  
Ypsilanti, MI 48197

North Star Nursery  
Route 13  
Williamstown, NY 13493

Sakuma Bros. Farm  
Box 427  
Burlington, WA 98233

**Sources of PYO Supplies**

Cordage Packaging  
66 Janney Road  
Dayton, OH 45404

Dewey-Carter Co. (sign kits)  
Box 822  
Doylestown, PA 18901

Fruit Picking Equipment Co.  
Lawrence, MI 49064

Fruit & Produce Packaging Co.  
Div. Anderson Box Co.  
Box 1851  
Indianapolis, IN 46206

Ben Meadows Co. (flags)  
3589 Broad Street  
Atlanta, GA 30366

Metro Equipment Corp. (scales)  
187 Agnew Station  
Santa Clara, CA 95054

Midland Plastic (permants)  
3001 East 30th Street  
Indianapolis, IN 46218

Packaging Corp of America  
1422 Packers Avenue  
Madison, WI 53704

**Sources of Promotional Items**

American Knitwear  
and Fabric Emblem Manufacturers  
Plaistow, NH 03865 (shirts and emblems)

Lou Nor  
244 Park Avenue, N.W.  
New Philadelphia, OH 44663 (strawberry and fruit jewelry items)

**Sources of Mechanical Supplies**

Ahren's (see above)

Friday Tractor Co.  
69226 Cr 687  
Hartford, MI 49057

Mechanical Transplanter Co.  
P.O. Box 10088  
1150 South Central Avenue at US 31  
Holland, MI 49423

Kennco Mfg. Inc.  
P.O. Box 1158  
Ruskin, FL 33570

### Supplemental Reference Sources

- Strawberry diseases in Michigan. S. Perry and D. Ramsdell. 1983. MSU Ag Facts Ext. Bull. #-1728, Mich. St. Univ. Coop. Ext., E. Lansing, MI. 4 pp. (includes nice color photographs of strawberry disease symptoms).
- Strawberry Diseases I. #X699.54. Vocational Agric. Serv., Univ. of Ill., College of Agric., 1401 S. Maryland Dr., Urbana, IL 61801. (Each single sheet consists of a series of color photos on the front and text descriptions on the back. Very nicely done. Cost \$0.20 each sheet.)
- Strawberry Diseases II. #X699.55. Vocational Agric. Serv., Univ. of Ill., College of Agric., 1401 S. Maryland Dr., Urbana, IL 61801. (Each single sheet consists of a series of color photos on the front and text descriptions on the back. Very nicely done. Cost \$0.20 each sheet.)
- Compendium of Strawberry Diseases. J. L. Maas (editor). 1984. American Phytopathological Society, 3340 Pilot Knob Road, St. Paul, MN 55121. 138 pp., incl. 148 color photos. (Excellent reference. Includes insect arthropod and mollusc pests as well as diseases. Cost \$20.00.)