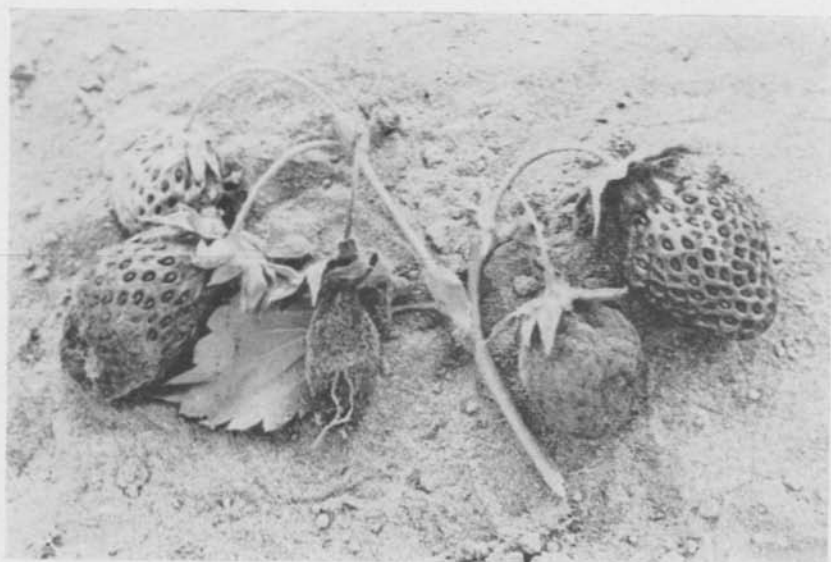


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Diseases of Small Fruits in Idaho

By
EARLE C. BLODGETT



Botrytis rot on strawberry fruit showing various stages of development.

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TABLE OF CONTENTS

	Page
BRAMBLES	5
Virus Diseases	5
Mosaic	5
Leaf Curl	6
Streak	7
Parasitic Diseases	7
Gloeosporium Blight	7
Canker, Die-back, and Leaf Spot	8
Fruit Rots	9
Crown Gall	10
Powdery Mildew	11
Spur Blight	11
Orange Leaf Rust	12
Non-parasitic Diseases	12
Chlorosis	12
Winter Injury	13
Sun Scald	13
Snow Injury	13
Nutritional	14
Miscellaneous Diseases	14
Tip Blight	14
Rough Bark	14
Crumbly Fruit	15
Nubbins	15
BUSH FRUITS	15
Parasitic Diseases	15
Powdery Mildew	15
Anthracnose	16
White Pine Blister Rust	17
Non-parasitic Diseases	18
Chlorosis	18
Sun Scald	18
GRAPES	18
Parasitic Diseases	18
Fruit Rots	18
Powdery Mildew	18
Crown Gall	19
Slime Mold	19
Non-parasitic Diseases	19
Chlorosis	19

STRAWBERRIES	Page 20
Parasitic Diseases	20
Leaf Spot	20
Leaf Scorch	21
Fruit Rots	21
Root Rots or Black Root	22
Powdery Mildew	22
Slime Molds	23
Virus Diseases	23
Crinkle	23
Yellows	24
Witches Broom	24
Stunt	24
Non-parasitic Diseases	25
Chlorosis	25
Frost Injury	25
June Yellows	26
Miscellaneous Diseases	26
Cat-facing	26
Cyclamen Mite Injury	27

Diseases of Small Fruits in Idaho

By

EARLE C. BLODGETT*

SMALL FRUITS are grown commonly in farmstead gardens and city backyards and in many commercial plantings in Idaho. The production of these small fruits represents an industry of considerable value. The returns, however, from most of the plantings frequently are reduced seriously by one or more of the common diseases which affect these crops.

The purpose of this bulletin is to describe the symptoms and to recommend control measures for the diseases of small fruits which are known to occur in the state.

BRAMBLES

Virus Diseases

Mosaic

There are at least two types of mosaic found on brambles. They are known as "red raspberry mosaic" and "yellow mosaic." The red raspberry mosaic is much more common, but the true identity of all the types of mosaic on the various brambles is not fully known.

DISTRIBUTION: General throughout the state where brambles are grown and especially severe in the Boise valley and Twin Falls areas.

IMPORTANCE: Mosaic represents the most common and most serious disease of brambles in Idaho. Probably very few patches are perfectly clean and many of them carry 100 per cent infection. In some instances growers think they have a new variety. Mosaic limits profitable raspberry growing generally in the state.

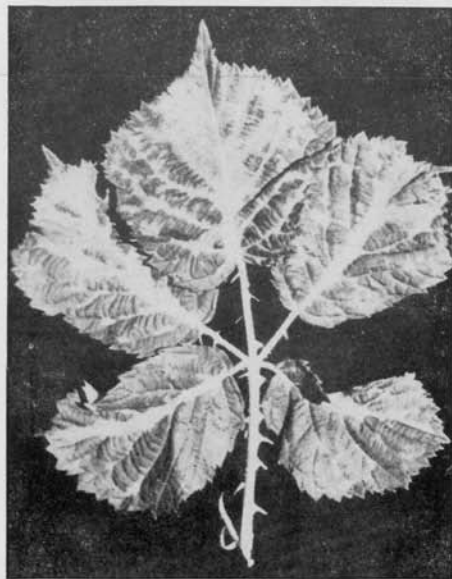


Figure 1.—Mosaic on Himalaya blackberry. The white areas are light green or yellow and the leaf presents a mottled pattern.

CAUSE: Mosaic is caused by a virus which is present in the juice of all parts of the plant. The virus is spread, often very rapidly, from diseased to healthy plants by aphids as they feed.

SYMPTOMS: The different bramble species and varieties vary considerably in the way they react to mosaic. The most common symptom is a mottling of the leaves with patches of light green or yellow scattered over the leaf area (*Fig. 1*). The color of affected plants appears to be a greenish yellow, the leaf edges are usually cupped downward, the plants and foliage are dwarfed and are late in beginning spring

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Figure 2.—Severe mosaic on blackberry showing dying back of fruiting canes and only weak new growth. The fruit is seedy and shriveled.

growth. On blackcaps, which are very susceptible, the young growth often dies back and the berries dry up and are seedy. Affected brambles usually lose vigor rapidly and die out or become unproductive (*Fig. 2*). Symptoms of mosaic can be seen only on growing plants; therefore, the disease cannot be detected in dormant nursery stock.

CONTROL: Plant only clean, healthy, certified stock. Rogue out and destroy affected plants as soon as they appear. Separate the black and purple raspberries as far as possible from other brambles. Plant resistant varieties when feasible:

Red: Newburgh, Marcy, Lloyd George, Washington.

Black: Logan or New Logan.

Leaf Curl

DISTRIBUTION: This disease has been noted in the Twin Falls and Boise Valley areas and around Moscow in scattered plantings.

IMPORTANCE: At present leaf curl is not important, but it may become very serious.

CAUSE: Leaf curl is caused by a virus which is spread by aphids slightly different from those spreading the mosaic virus.

SYMPTOMS: Affected plants are small, weakened, and unproductive. The foliage is a normal green color, but is very much dwarfed and the leaflets are curled downward (*Fig. 3*). Frequently plants are seen which present the appearance of being infected by both mosaic and leaf curl, particularly in the blackcaps.

CONTROL: Plant only clean, healthy, certified stock. Rogue out and destroy affected plants as soon as they appear. Separate the black and purple-caps as far as possible from other brambles.

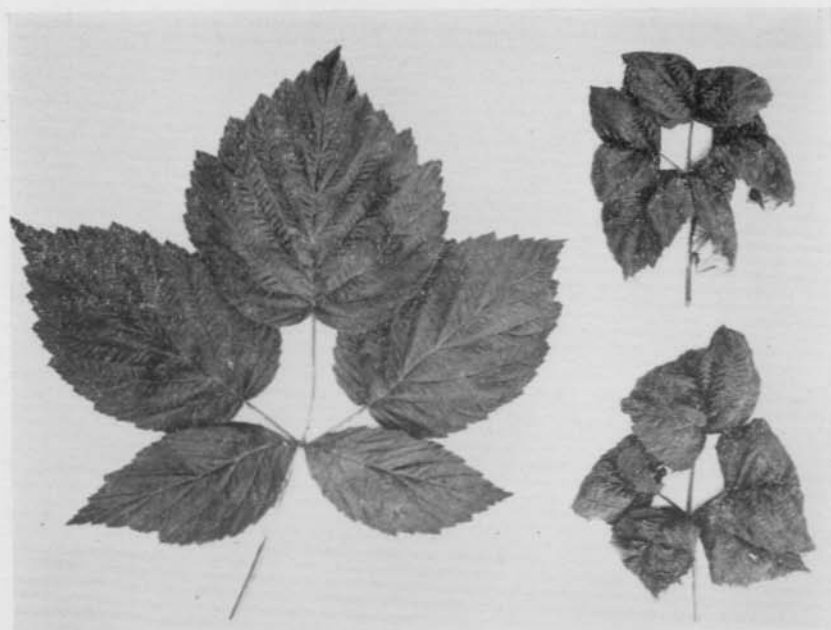


Figure 3.—Leaf curl of raspberry. The virus causes the leaves to cup downward and inward. The color is about normal green. Healthy leaf on left.

Streak

DISTRIBUTION: Not well known; specimens collected at Payette.

IMPORTANCE: Apparently this disease is of little importance although injury may become severe.

CAUSE: Streak is caused by a virus, but the method of spread is not known.

SYMPTOMS: This disease is characterized by blue, discolored markings near the base of canes. Streak is confined to black and purple-cap varieties and may cause severe loss of vitality and eventual dying of plants.

CONTROL: Same as for leaf curl.

Parasitic Diseases

Gloeosporium Blight

DISTRIBUTION: Not known except that it is common in plantings at Moscow and probably is present quite generally.

IMPORTANCE: Severe injury occurs and limits production.

CAUSE: Gloeosporium blight is caused by a parasitic fungus (*Glomerella cingulata*).



Figure 4.—Cane canker and die-back of youngberry. The reddish purple spots are similar to those caused by the *Gloeosporium* blight fungus.

before blossoming, and again with 6-6-50 early in the fall. The old canes should be removed after harvest.

Canker, Die-back, and Leaf Spot

DISTRIBUTION: Very common in the Lewiston area, noted in Nampa, Parma, Moscow, and is probably general.

IMPORTANCE: Very important and may sharply limit production of youngberry, boysenberry and dewberry.

SYMPTOMS: This disease is characterized by a cankering and weakening of over-wintered canes. The spots on some varieties frequently are small and give a speckled appearance, while on others the cankers are elongated and often more or less localized around the buds. Each spot usually has a light gray center bordered by a reddish brown margin (Fig. 4.) Small dark specks may be found on the diseased area. These specks are the fruiting bodies of the fungus containing the spores.

Weakened canes are susceptible to winter and drought injury. The disease is found on youngberry, boysenberry, dewberry, and several varieties of blackberry. In other states *Gloeosporium* blight is found on red and black raspberries, but so far it has not been recorded on these in Idaho.

CONTROL: Preliminary tests suggest spraying with Bordeaux mixtures¹ 6-6-50 in the delayed dormant stage, 4-4-50

¹ Bordeaux mixture is made with copper sulphate and lime. The proper procedure for making the home-made mixture is as follows: Dissolve the required amount of copper sulphate in a wooden or earthenware vessel (never in a metal container) and then dilute to about $\frac{3}{4}$ the final spray volume in the tank. Slake the lime carefully and let stand for a few minutes. If hydrated lime is used, add $\frac{1}{2}$ more and mix with water making a smooth milk of lime. In mixing, add the lime slowly to the copper sulphate solution while the spray is being stirred vigorously. Use Bordeaux mixture at once as it deteriorates rapidly if let stand. The formula varies but the usual one 4-4-50 represents 4 lbs. copper sulphate, 4 lbs. stone lime, and 50 gallons of water.

CAUSE: This disease is caused by one or more parasitic fungi belonging to the genus *Septoria*.



Figure 5.—Leaf spot of youngberry. This is due to the same fungus causing cane canker and die-back.

SYMPTOMS: In general the symptoms are identical with the *Gloeosporium* blight disease and the results are similar (Fig. 4). The black specks in affected canes are slightly larger and more round, and under moist conditions exude whitish colored tendrils of spore masses; in addition a leaf spot often is associated with the canker disease and is characterized by light gray spots bordered by reddish brown margins (Fig. 5).

In Idaho this disease apparently is confined to youngberry, boysenberry, loganberry, and dewberry, while elsewhere the leaf spot phase may be serious on red and black raspberries.

CONTROL: Measures used for *Gloeosporium* blight should be suitable in this case.

Fruit Rots

DISTRIBUTION: General, although more severe in the more humid sections.

IMPORTANCE: Under favorable conditions the fruit rots, particularly in transportation, may account for very severe losses. During wet seasons damage may be extensive in the field.

CAUSE: Rots of bramble fruits are caused largely by species of *Botrytis*, *Rhizopus*, and *Penicillium*.

SYMPTOMS: 1. *Botrytis*—a soft rot of the fruit develops, finally causing a complete breakdown. Affected tissue is covered with a gray powdery mass of mycelium and spores.

2. *Rhizopus*—a soft watery rot rapidly and completely affecting everything in the container. Long "whiskers" with small black bodies cover the rotted fruits.

3. *Penicillium*—this rot develops slower and usually is identified by the presence of the blue masses of spores on diseased fruit.

CONTROL: Fruit rots are kept in check by strict sanitation and care in handling, storing, and marketing. Bramble fruits should not be bruised or handled more than necessary. They should be kept in a cool, well-ventilated place and consumed as promptly as feasible. Rotted fruits left on the plants are a serious menace, and this should be prevented by regular, careful picking.

Crown Gall

DISTRIBUTION: General where brambles are grown. Severe cane gall development has been noted on boysenberry at Emmett, Fruitvale, and Sandpoint.

IMPORTANCE: In some cases crown gall has caused complete failure of plantings; in others the disease has sharply limited production. Infected plants are more easily winter injured.

CAUSE: Crown gall is caused by bacteria (*Phytophthora tumefaciens*) which stimulate plant cells to abnormal growth causing the galls. Recent evidence indicates that the cane galls are caused by another species, *Phytophthora rubi*.

SYMPTOMS: Swellings, varying in size from those just visible up to 3 or 4 inches in diameter occur on the roots, crown, or canes of diseased plants (Fig. 6). The cane galls usually are smaller and more elongated. The galls vary in color from fleshy white, when young, to tan, brown, and later almost black. They are hard and woody when old.

CONTROL: Only healthy, certified plants should be set when establishing a planting. Brambles should be planted on new land if possible and should not follow orchard trees since the bacteria can live for several years in the soil. Badly affected plants should be removed and, if feasible, the soil disinfected.

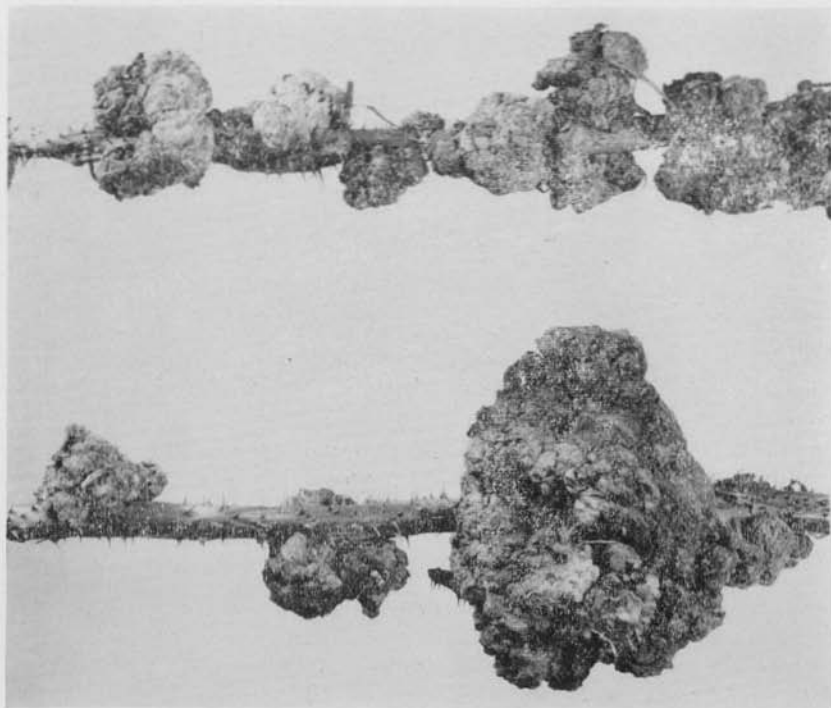


Figure 6.—Crown gall on canes of boysenberry. Most of the fruiting wood is affected and vigor of the plant reduced.

Powdery Mildew

DISTRIBUTION: Collections have been made in several places in the state.

IMPORTANCE: At present mildew is of very little concern to most growers, but there is evidence that the disease is increasing in severity and may become a major problem.

CAUSE: Powdery mildew is caused by a parasitic fungus (*Sphaerotheca humuli* or *pannosa*) similar to the mildew on roses. It lives over winter on affected canes and is spread during the summer by small wind blown spores.

SYMPTOMS: The leaves and young shoots may be covered with a gray powdery mass of fungus spores. Growth of the plants is stunted and deformed and the canes weakened.

CONTROL: Thinning out thick rows, providing good air circulation and keeping tall weeds out of a patch will help keep mildew down. Dusting with sulphur is helpful but may cause some injury to raspberries.

Spur Blight

DISTRIBUTION: Recorded on red raspberry near New Meadows and Moscow, and it probably occurs elsewhere in the state where humid conditions prevail.

IMPORTANCE: Very minor except in one planting mentioned where damage is severe.

CAUSE: Spur blight is caused by a fungus, *Didymella applanata*, which lives on the canes usually near the buds. It overwinters on these canes in small black bodies and spores attack the new shoots next year.

SYMPTOMS: Spur blight is characterized by reddish brown lesions appearing around the buds or spurs of the canes. It first shows on the young canes during the late summer. The next spring the bark on the diseased area has turned gray and shows little black pimples—fruiting bodies of the fungus (Fig. 7). Affected buds either die or make feeble growth and fruit poorly.

CONTROL: Cut out infected canes and spray with Bordeaux mixture 3-4-50 when the new canes are about a foot high. It is desirable to spray only the young canes.

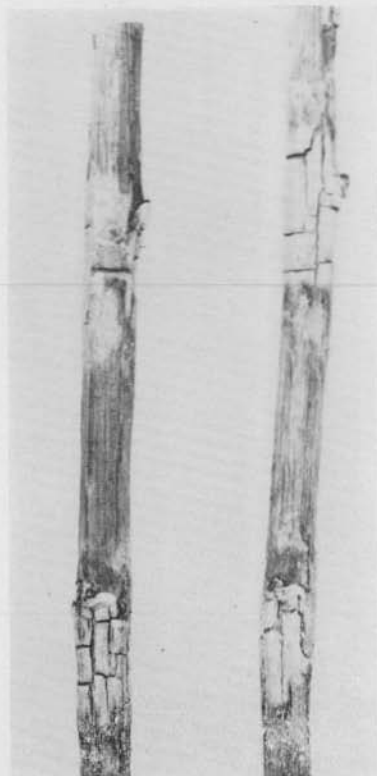


Figure 7.—Spur blight of raspberry showing the dead areas near the buds. Diseased bark turns gray and shows small black dots or bodies containing the fungus spores.

Orange Leaf Rust

DISTRIBUTION: This disease has been found only in scattered plantings as the result of diseased plants being shipped in. There is no evidence that this disease organism spreads under Idaho conditions.

IMPORTANCE: At present this rust is unimportant, but growers should be able to diagnose and control the disease when they find it.

CAUSE: Orange leaf rust is caused by a fungus called *Gymnoconia interstitialis* which becomes systemic in affected plants and appears in the young suckers and tops of plants. The fungus produces spores which appear as bright orange coloring on the underside of affected leaves.

SYMPTOMS: Orange leaf rust is characterized by severe dwarfing, fine narrow leaves on spindly witches broom stems, and by orange colored masses on the underside of affected leaves. Severely diseased plants usually die the second or third year.

CONTROL: Remove infected plants as soon as they are detected.

Non-parasitic Diseases

Chlorosis

DISTRIBUTION: General in southern Idaho from Weiser throughout the Boise, Twin Falls, Pocatello sections, and south toward Utah and north through Idaho Falls and Rexburg.

IMPORTANCE: This trouble is very serious generally and in many local plantings sharply limits production and renders plants more liable to winter injury.

CAUSE: The usual type of chlorosis present on brambles is caused by excess lime in the soil which ties up available iron so the plants are unable to form chlorophyll. The lime may be present generally in the soil (as in some sandy soils), or it may appear in a definite hard pan layer occurring at varying depths.

SYMPTOMS: Leaves turn yellow first at the edges and between the veins, finally resulting in a clear yellow, almost white leaf that begins to die at the edges. The veins remain green until the condition is quite advanced. Production drops off sharply and vigor of the plant is reduced.

CONTROL: This is difficult. Selection of planting sites where high lime content does not exist and proper irrigation practices are important. It is generally agreed that excessive water and poor drainage are harmful. The soil should be well fertilized (10-20 tons of barnyard manure per acre) and the planting probably will do better under a mulch system than in clean cultivation. Growers also use a 2 per cent iron sulphate solution as a spray on affected plants. Soil correctives which tend to make the reaction acid are helpful.

Winter Injury

DISTRIBUTION: General over the state.

IMPORTANCE: Actual losses are very hard to estimate because so many other factors are involved. Plants weakened by mosaic, crown gall or leaf spot diseases are more susceptible to winter injury.

CAUSE: The direct cause is low temperature, but the time of year when this occurs is very important. Early fall freezes before the canes are dormant and late spring freezes are more serious than very low temperatures when the plants are dormant. Snow cover is of great importance also, tending to reduce the injury.

SYMPTOMS: The usual symptoms show as weakened canes, bark splitting, dying back, and reduced vitality. Sometimes the plants will die if weakened by other causes.

CONTROL: The following points should be considered:

1. Avoid low, cold areas where air drainage is poor.
2. Provide good growing conditions and produce vigorous plants.
3. If possible regulate the moisture supply so the canes mature early in the fall and the plants enter the winter with good soil moisture.
4. Grow hardy varieties: The Chief and Latham are very hardy and the Taylor in limited trials has shown cold resistance. Washington is very promising.

Sun Scald

Berries exposed to the sun during hot weather will often become scalded, particularly on the exposed side. The red color changes to a grayish white and the individual carpels begin to shrivel and dry up. A sour taste is present. On some varieties even browning or blighting of foliage is severe in hot, protected places. Control of leaf spot or other diseases that reduce the foliage, proper pruning and training to produce vigorous growth and foliage to shade the fruit will help reduce the danger of sun scald.

Snow Injury

In regions of the state where a heavy snow cover is common, severe injury to bramble canes may occur. This consists of breaking the canes off at the crown or above, tearing off side shoots and buds, and often causing severe lodging.

The damage may be reduced by growing the plants in wide hedge rows rather than the single plant system and by not pruning the old canes until spring.

Nutritional

In some plantings the shallow soil is underlaid by pure sand, by coarse gravel, or by hard pan. In the former cases and on a "light soil" fertility may be a very important matter. Plants may be dwarfed, sickly, and winter kill badly. Correction is difficult but heavy applications of manure (20 tons per acre) or commercial fertilizers (200 lbs. ammonium sulphate) will be found helpful. In some cases application of other fertilizers may be necessary. The deficiency disease situation in small fruit culture in Idaho is not well understood at present.

Miscellaneous Diseases

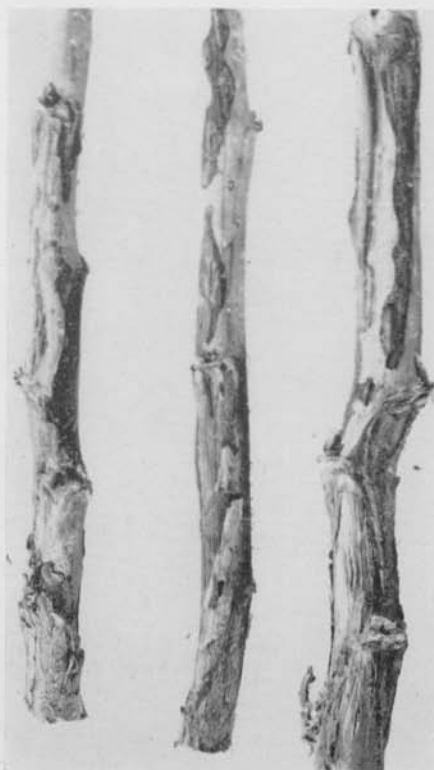


Figure 8.—Bark splitting and cankering of red raspberry. Cause is unknown.

Tip Blight

This condition, characterized by a sudden wilting and tip dying of young blackcap canes, is quite common generally. It often is associated with wind injury which causes the canes to break from the crown. Proper pruning and training, and perhaps staking, are advised.

Rough Bark

This is probably a phase of winter injury since it occurs most frequently after severe winters. Other factors such as virus diseases may also be involved.

A peculiar type of symptoms on canes of Newburgh particularly has caused some concern. The discolored areas show on the lower canes late in the summer and result in death and shedding of the outer bark (Fig. 8). No apparent damage is associated with this condition.



Figure 9.—Flower shoot of blackberry showing "nubbins" or improperly developed fruits. Cause unknown.

Crumbly Fruit

This trouble is rather common. Plants appear normal except that the fruit crumbles and falls apart. The cause is not definitely known but it has been suggested that the defect is characteristic of certain seedling plants. Crumbly fruit has sometimes also been associated with virus diseases such as mosaic.

Nubbins

This trouble refers to the ill-formed and only partially developed fruits (*Fig. 9*). It may be due to faulty fertilization of the flowers, to frosts, and possibly to a fungus. In some cases it appears to be caused by a virus, or perhaps it is a result of hereditary factors.

BUSH FRUITS

Parasitic Diseases

Powdery Mildew

DISTRIBUTION: General over the state.

IMPORTANCE: The most serious disease affecting gooseberries and frequently severe on currants.

CAUSE: A fungus, *Sphaerotheca mors-uvae*, which overwinters as mycelium on affected shoots and leaves and also in small black bodies on the affected tissues. The fungus is superficial and does not cause a rot.



Figure 10.—Powdery mildew on red currant leaves and shoots. The young growth is severely dwarfed and covered with a mass of grayish white powder—spores of the fungus.

SYMPTOMS: The first appearance of powdery mildew is usually on the fruit as a white powdery growth which rapidly affects the whole fruit and attacks leaves and young shoots (Fig. 10). All parts of the plant are dwarfed and misshapen, and growth is reduced. Later in the season the white mildew turns brown and almost black with small dark bodies embedded in the mycelial mat.

CONTROL: Lime sulphur spray 1-30 applied before blossom and after blossom should give good control. Under very severe conditions another spray about 2 weeks later may be necessary. This material may cause some injury if hot weather follows, but the damage is usually minor. Bushes and crowns should be thoroughly covered.

Anthracnose

DISTRIBUTION: This disease has been found fairly general in northern Idaho but has not been reported in the southern part. It is common on wild *Ribes*.

IMPORTANCE: Losses usually are minor but under favorable conditions the disease may become very severe causing reduction in vigor of the plants, defoliation, and subsequent sunscald.

CAUSE: Anthracnose is caused by a fungus, *Pseudopeziza ribis*, which produces small sickle-shaped spores during the summer and ascospores in the early spring on overwintered leaves. It prefers moist conditions.

SYMPTOMS: The disease is characterized by the presence of very small, brown spots on the leaves (Fig. 11). Under severe conditions the leaf surface becomes a mass of brown specks, the tissue yellows and dies, and the leaves fall off. Under moist conditions there may be white glistening masses of spores on the spots.



Figure 11.—Anthracnose of red currant showing the small brown spots. The leaves turn yellow and fall early.

CONTROL: Bordeaux mixture 3-4-50 applied just after blossom and again in 2-3 weeks has given excellent control. The measure used for powdery mildew will afford some protection and under most conditions will be sufficient. Sanitation and the destruction of old leaves are helpful.

White Pine Blister Rust

This disease is confined to northern Idaho and affects wild *Ribes* most commonly. The cultivated black currant, however, is especially susceptible and should not be grown in the state. The rust fungus causes a spotting of *Ribes* leaves (Fig. 12) and also the serious Blister Rust of White Pines. The disease is seldom serious on cultivated *Ribes*, but where it occurs in Idaho the currant or gooseberry plants should be destroyed because of the threat to white pine timber.



Figure 12.—White pine blister rust on red currant. The infected areas are covered with yellow spore masses.

Non-parasitic Diseases

Chlorosis

Ribes plants are susceptible to lime-induced chlorosis, and symptoms may become very severe causing marked reduction in vigor and production. The trouble is confined to southern sections of the state. Control measures are not well worked out, but soil correctives may be used to advantage, particularly liberal application of barnyard manure.

Sun Scald

This trouble, common generally but more severe in the southern part of the state, may cause extensive damage. It is caused by high temperatures and direct exposure to the sun. The berries may actually be cooked, turn white, and shrivel or sour. Sun scald is much worse on defoliated plants and those in poor vigor. Control consists of protecting plants from other diseases, providing good growing conditions and proper pruning.

GRAPES

Parasitic Diseases

Fruit Rots

DISTRIBUTION: General where grapes are grown or used. The rots are usually not important field diseases but are common in storage or shipping.

IMPORTANCE: Collectively the three most common rots are very serious and may cause complete destruction of the fruit in a short time.

CAUSE: Perhaps the most common rot is caused by *Rhizopus nigricans*. Others of importance are those caused by *Botrytis* and *Penicillium*. These fungi are common everywhere and can live on nearly any type of organic matter.

SYMPTOMS: The symptoms on grapes are very similar to those on brambles and strawberries.

CONTROL: Fruit should be handled carefully and sanitation should be practiced. All containers must be new or clean, and decayed fruit should be destroyed in order to keep the fungus spores from spreading.

Powdery Mildew

DISTRIBUTION: Collected on plants in Boise, but the disease undoubtedly occurs elsewhere in the state.

IMPORTANCE: At present powdery mildew is of slight importance, but experience elsewhere would indicate that the disease may become serious. A very severe outbreak in one planting at Boise occurred in 1941.

CAUSE: *Uncinula necator*, a fungus which lives superficially on the foliage, fruit, and young shoots. It winters on the old leaves and shoots in small black bodies. Spores are produced in abundance during the summer.

SYMPTOMS: This disease on grapes appears very much like powdery mildew on gooseberry and other hosts. Affected parts are covered with brown powdery growth and later in the fall with small black bodies. Affected fruits are worthless, and production is greatly reduced if attacks continue.

CONTROL: Dusting with sulphur has proved effective. Start when mildew first appears and repeat as necessary to keep the new growth covered.

Crown Gall

DISTRIBUTION: General over the state.

IMPORTANCE: Losses are difficult to estimate, but the disease is capable of causing serious injury.

CAUSE: Bacterial organisms called *Phytophthora tumefaciens*.

SYMPTOMS: Galls or swelling usually occurs on the canes or crown of the plants where they appear as elongated, corky, or woody masses.

CONTROL: Cut out infected canes and in severe cases remove the entire plant. Only healthy plants should be set out.

Slime Mold

Specimens were collected in Lewiston in 1937. Symptoms consist of large grayish to black, fluffy powdery masses on the canes and are similar to those described for strawberry, (page 23). The fungus causes very little damage and control measures probably are not necessary.

Non-parasitic Diseases

Chlorosis

DISTRIBUTION: General in southern Idaho and noted in Lewiston.

IMPORTANCE: Grapes are particularly susceptible to injury from lime induced chlorosis. Reduction in vigor of the plants in many areas limits profitable production, and some plantings actually die out.

CAUSE: Excess lime in the soil prevents normal utilization of iron in the plant (See Bramble Chlorosis, page 12).

SYMPTOMS: Leaves turn yellow first at the edges and between the veins finally resulting in a clear yellow, almost white, leaf that usually begins to die at the edges. Production drops off sharply and vigor of the plants is reduced.

CONTROL: Limited trials indicate that spraying with 2 per cent iron sulphate solution has given satisfactory control although the treatment is temporary. Selection of planting site, culture, fertilizers, and soil correctives should be considered. Recent work in Utah indicated that grafting susceptible varieties on resistant roots gives good control of chlorosis.

STRAWBERRIES

Parasitic Diseases

Leaf Spot

DISTRIBUTION: The disease is found generally over the state but is especially common in the more humid areas such as Coeur d'Alene, Sandpoint, Moscow, Lewiston (Clearwater drainage), and locally in higher elevations.

IMPORTANCE: Usually leaf spot is a minor disease, but in certain seasons it sharply limits production and reduces the vigor of plants for the next year.

CAUSE: Leaf spot is caused by a fungus *Mycosphaerella fragariae* which overwinters on the old leaves and attacks the young foliage as it appears.



Figure 13.—Leaf spot of strawberry. The diseased areas have a reddish purple border and ashen gray center.

SYMPTOMS: The disease is typically a leaf spot, but the fungus may also attack the pedicels, the petioles, and probably the runners in severe cases. The spot may be fairly large with a purplish red margin and always an ashen gray center (Fig. 13). Small black specks often are visible in the center of the spots. In severe cases the spots may run together and the whole leaflet will be blighted. Lesions on the stems and fruit stalks may weaken them so leaves and fruit wither up.

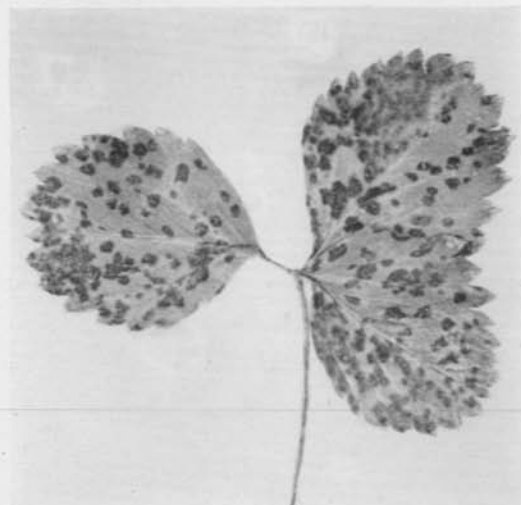
CONTROL: In plantings where leaf spot is present, the practice of mowing and burning the leaves after harvest is recommended. If this is done carefully and regularly it may be sufficient; but a spray program is usually necessary in bad cases. Use Bordeaux mixture 4-4-50

in the spring as soon as the first leaves are of good size, again just before blossom, and if necessary another application in the early fall. Overhead irrigation tends to favor leaf spot. When setting out a new patch, remove and destroy all leaves from the plants so the fungus will not be carried to the new plants.

Leaf Scorch

DISTRIBUTION: Similar to that of leaf spot.

IMPORTANCE: Leaf scorch is as yet unimportant although one planting near New Meadows and one at Coeur d'Alene were severely affected.



CAUSE: *Diplocarpon earliana*, a fungus that develops much the same as the one causing leaf spot.

SYMPTOMS: Leaf scorch is somewhat similar in appearance to leaf spot except that the areas do not have a light center, and they may be larger and less clearly defined (Fig. 14).

CONTROL: Same as for leaf spot.

Figure 14.—Leaf scorch of strawberry. The spots do not have light centers.

Fruit Rots

DISTRIBUTION: Wherever berries are grown.

IMPORTANCE: Very great.

CAUSE AND SYMPTOMS: Some fungi may affect fruit while it is still on the plant even in the green stage, while others are primarily transit or storage rots. On strawberries the following are the most common:

1. *Rhizopus* or *black mold rot*. Fruit is completely broken down, leaving a soft watery mass covered with long, coarse, white threads or whiskers. This fungus frequently works on berries while they are still on the plants, especially those fruits which touch the ground.
2. *Penicillium* or *blue mold rot*. Affected fruit is covered with blue, powdery spore masses.

3. *Botrytis* or *gray mold rot*. Berries are covered with a gray moldy growth (See cover illustration). Field infection is frequent.
4. *Rhizoctonia* or *brown hard rot*. Affected fruit becomes a dry, hard mummy. All these fungi may live in the soil and attack the fruit when there is excess moisture. They work fast and may cause tremendous losses.

CONTROL: Do not overwater and if practical provide a straw mulch to keep the berries off the ground. Handle berries carefully, store and ship at low temperatures, and use at once. Practice sanitation and do not scatter decayed berries around the patch. Use clean containers for picking. In some cases it will pay to pick all the old spoiled fruits and bury them instead of letting them infect other fruit on the plants.

Root Rots or Black Root

A great many factors are involved in the complex condition known as root rots or black root.

DISTRIBUTION: General over the state.

IMPORTANCE: Very great; probably the most common limiting factor in profitable production.

CAUSE: Adverse soil conditions such as excess alkali, poorly drained areas, and overmanuring of soil may produce excessive root rot or crown rot. *Rhizoctonia* and other fungi are frequently the direct cause of root rot condition and it's often difficult to determine which factor is the most important.

SYMPTOMS: The roots of the plants become dark brown or black and rot off. It must be remembered that old strawberry roots naturally will turn dark but will still be white and healthy inside.

CONTROL: About the only available suggestions are to grow strawberries in favorable soil locations, provide good growing conditions and practice short rotations. Do not plant strawberries following potatoes.

Powdery Mildew

DISTRIBUTION: The only specimens collected are from northern Idaho.

IMPORTANCE: Minor but can become of considerable importance.

CAUSE: A fungus called *Sphaerotheca pannosa* which overwinters on the old leaves.

SYMPTOMS: A white, felt-like growth appears on the foliage, stems, and young fruits giving a powdery appearance. Later the fungus growth turns dark brown. The plants and fruits are dwarfed and misshapen.

CONTROL: Cut and destroy all the old foliage after harvest. After growth starts, dust with sulphur as needed.



Figure 15.—Slime mold growth on strawberry foliage.

Slime Molds

Damage caused by the grayish, fluffy masses of slime mold (fungus) growth on strawberry plants has occurred in low, damp places (*Fig. 15*). This is a minor trouble and not very common. Control would likely be concerned with sanitation. Diseased leaves and severely affected plants should be destroyed.

Virus Diseases

Crinkle

DISTRIBUTION: Widely scattered on plants shipped in from affected areas.

IMPORTANCE: At present the disease is minor, but it is capable of causing serious losses.

CAUSE: A virus transmitted by certain aphids. All runner plants from diseased plants carry the virus.

SYMPTOMS: Affected plants have a yellowed appearance, the leaves are smaller, crinkled and rough, and the whole plant is dwarfed, particularly the petioles (*Fig. 16*). The fruit is small, often misshapen, and of poor quality.

CONTROL: Plant only healthy stock and remove diseased plants as soon as they appear.



Figure 16.—Strawberry crinkle caused by a virus. The leaves are yellowed, crinkled and dwarfed.

Yellows

DISTRIBUTION: Widely scattered on plants shipped in from affected areas.

IMPORTANCE: Very minor at present.

CAUSE: A virus transmitted by certain aphids. All runner sets from diseased plants carry the virus.

SYMPTOMS: Plants are dwarfed, yellowed in appearance, and yield small, poor quality fruits. The leaves are characteristically yellowed near the margins, much dwarfed, and curled or cupped.

CONTROL: Same as for crinkle.

Witches Broom



Figure 17.—Witches broom of strawberry showing the dwarfed foliage and excess shoots at the crown.

DISTRIBUTION: The only specimens collected came from Coeur d'Alene, but undoubtedly the disease is found elsewhere.

IMPORTANCE: Minor at present but it can ruin a planting or the stock in a year or two.

CAUSE: A virus transmitted by aphids. All runner sets from infected plants are diseased.

SYMPTOMS: Characteristically the leaf petioles are slender, upright, and very numerous from the crown. The foliage is smaller and lighter colored than normal (*Fig. 17*). Runners, when they form, are typically very short.

CONTROL: Same as for crinkle.

Stunt

DISTRIBUTION: Specimens have been collected in a planting near New

Meadows. (Diagnosis has been by symptoms only.)

IMPORTANCE: Injury in this one planting has been severe.

CAUSE: A virus transmitted by aphids. All runner sets from diseased plants are affected.

SYMPTOMS: The diseased plants are greatly dwarfed or stunted, but the petioles are upright. The very small leaves have a pronounced cupped appearance and are about normal green in color. Fruit is small and seedy.

CONTROL: Same as for crinkle.

Non-parasitic Diseases

Chlorosis

DISTRIBUTION: General from Weiser through the Boise valley, Twin Falls, and southeast toward Utah and northeast along the upper Snake River.

IMPORTANCE: Probably one of the most serious production diseases in the state.

CAUSE: Excess lime in the soil is the most common cause. This condition prevents the normal use of iron in formation of chlorophyll. Alkali in the soil will cause chlorosis; so will excess watering and some other factors.

SYMPTOMS: The chlorosis referred to here is characterized by a progressive yellowing of the leaves from the tips and margins. Later only the veins are green, and finally the whole leaf may become a clear yellow or a papery white. Death of leaves and plants may follow.

CONTROL: Select the proper site where the lime concentration in the soil is not too high. In small plantings where the cost is not an important factor, annual heavy applications of manure will prove helpful. Provide good drainage. Short rotations.

Good results have been reported following the spraying of plants after harvest with a 2-4 per cent iron sulphate solution. The new growth usually will be green.

Frost Injury

This trouble can occur anywhere at almost any time of the year. Losses may be slight to complete. Symptoms usually consist of a dark center or black blossom on affected plants. Frost injury is often widely variable in its occurrence in a patch and not all blossoms on a plant may be killed. Control is difficult but proper selection of planting sites is important. It has been observed that irrigation during frosty periods may save some of the blossoms.

June Yellows

DISTRIBUTION: Widely scattered over the state.

IMPORTANCE: This is probably a minor disease.

CAUSE: Genetic abnormality. It is not transmitted but is perpetuated through runner plants.

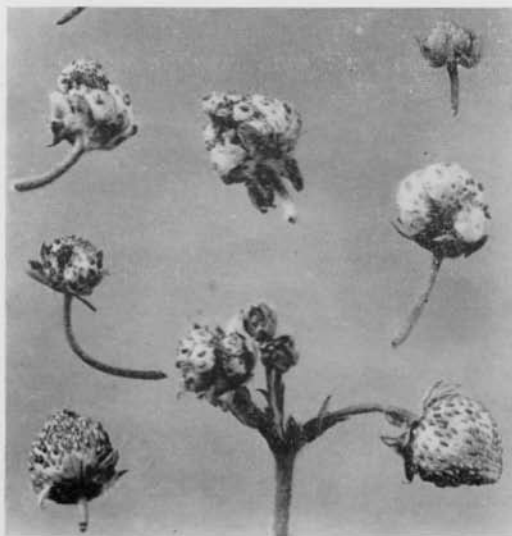
SYMPTOMS: Affected plants are about normal in size and appearance except that the leaves are yellowed. The yellowing is distinct in that it appears as a mottling or marbling of the green and yellow color. Often the yellowing seems to follow between the veins but sometimes the whole leaf is almost clear yellow. Great care must be used to distinguish this trouble from chlorosis, crinkle and yellows. Generally, plants affected with June yellows will green up and appear almost normal later in the season.

CONTROL: Secure yellows free plants and destroy affected plants as they appear. This condition does not spread as viruses do, but new plants may "break down" and runner plants increase in numbers.

Miscellaneous Diseases

Cat-facing

This trouble has been seen generally over the state and often is very



serious although it does not occur uniformly. The cause is obscure. Although frost injury has been most frequently mentioned as producing this condition, there must be other factors because cat-facing is often found on second crop everbearers and on first crop plantings when frost has not occurred (Fig. 18). Evidence points to certain insects (such as *Lygus* species) as the most likely cause. Some of these species breed on alfalfa and may migrate to the strawberry plantings from the alfalfa. Other cases are associated with cyclamen mite injury.

Figure 18.—Cat-facing of strawberry fruit. This condition is frequently associated with presence of *Lygus* spp. of insects and may be caused by frost.

Cyclamen Mite Injury

This condition is general but sporadic in its occurrence. The Mastadon variety is often severely affected. Affected plants are stunted, flattened, and bear poor quality, often cat-faced berries (Fig. 19). The leaves are crinkled and in general appear much like crinkle caused by a virus. Cyclamen mite injury is due to the feeding of these mites on the young, unfolded leaves. For further information write for Idaho Extension Bulletin No. 129.

The positive identification of all the troubles of small fruits listed in this bulletin is difficult, but the descriptions and illustrations given may be of assistance. For recommendations pertaining to local conditions see your county agent.

Any new or unrecognized disease specimens should be mailed to the Department of Plant Pathology, Idaho Agricultural Experiment Station, Moscow, Idaho.



Figure 19.—Cyclamen mite injury on strawberry. Symptoms are quite similar to those of crinkle.

Control the diseases affecting your small fruits.

