

DISEASES OF HEAD LETTUCE IN MINNESOTA

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Published by the University of Minnesota, College of Agriculture, Extension Division, F. W. Peck, Director, and distributed in furtherance of the purposes of the cooperative agricultural extension work provided for in the Act of Congress of May 8, 1914.

INTRODUCTION

The commercial production of head lettuce, altho not a large industry, is an important industry in certain localities in Minnesota. Most of the commercial head lettuce in Minnesota is grown on peat or muck soil in the northeastern part of the state. Practically all of this soil has been brought under cultivation for the first time during the last ten years. The soil, therefore, was essentially virgin when the growing of head lettuce was begun.

New soil of this kind is practically free from plant diseases. The first few crops of lettuce grown on this new soil were therefore healthy and suffered little or no loss from disease. However, with the continued planting of lettuce, diseases were gradually introduced, and with each successive crop they became more firmly established. So rapidly have the diseases developed under this intensive type of farming that it is now difficult to grow a profitable crop of head lettuce on some of the older soils which have been cropped to lettuce continuously.

This is not strange because the same sequence of events nearly always occurs when new soil is brought under cultivation, especially when a single crop is grown year after year on the same soil. As long as a profitable crop can be grown, the average grower will not spend time and labor in disease control or disease prevention. It is only when the diseases become sufficiently destructive to make the crop unprofitable that any attention is given to the question of disease control. Then it is usually a very difficult matter. When diseases are once established in intensively cropped soil, it is only by intelligent co-operation among the growers and by strict adherence to the principles of sanitation and crop rotation that they may be held in check.

All disease-control measures are based on a knowledge of the nature and cause of the disease concerned. Only when the nature of the disease is thoroly understood can control measures be intelligently applied.

"Drop" One of Worst Lettuce Diseases

Drop is one of the most destructive diseases with which the lettuce grower must contend. Sometimes more than half of the plants in a field may be destroyed.

Symptoms May Appear at Any Stage

Plants may be killed at any stage of growth, but are most frequently attacked after the heads have begun to form. The older and outer leaves are the first to be killed. They wilt rapidly and fall flat

on the ground, leaving the heart leaves standing erect (Fig. 1). The leaves lose their gloss and become lighter in color than those of healthy plants. The fungus advances upward through the stem, and within a few days the entire plant wilts and dries up, leaving only a few dry dead leaves. (See picture on first page.) If the plant is pulled up during the early stages of the disease, it will be seen that the stem and leaf bases are decayed by a white cottony fungus that develops abundantly over the surface of the decayed area (Fig. 2). This fungus, called *Sclerotinia sclerotiorum* (Lib.) Masee, causes the disease. It lives from year to year in the soil and infects the lettuce plants from the soil, usually through the leaves that are in contact with the soil, or through the stem near the ground line. It can infect plants only under the very moist conditions which obtain under the spreading leaves of the rapidly growing plant.



Fig. 1. Early Stage of Lettuce Drop

The outer leaves are beginning to wilt and to lose their natural gloss.

If a diseased plant is examined carefully, many small, black, irregularly shaped bodies will be seen in and on the surface of decayed parts. These are the fruiting-bodies of the fungus and are known as sclerotia (Fig. 3a). It is by means of these that the fungus is able to live over winter and survive periods of drouth. If allowed to remain in the soil, these bodies lie dormant until the following spring, when they germinate and send up cup-shaped structures known as apothecia (Fig. 3b). These produce hundreds of thousands of spores which are blown into the air and scattered over the fields by the wind. Wherever the spores fall on the soil they may grow and destroy more plants if conditions are favorable. The spores never infect the lettuce plant directly, but attack it from the soil after it is established.

Control of Drop Is Difficult

Drop is a difficult disease to control completely, but much can be done to reduce the amount of loss.

Sanitation.—The best way to avoid losses from drop is to prevent the disease from developing and multiplying in the soil. As stated before, new soils are practically free from the disease. A few plants become diseased and on these a number of sclerotia are formed. If these are allowed to remain on the soil, they produce a crop of spores the following spring which will spread the disease to other parts of the field. Each year an increasingly greater number of plants become diseased, until after a few years large losses are suffered. On the other hand, if the first diseased plants are carefully removed and destroyed, or are treated with some strong fungicide, as copper sulfate or formaldehyde, there will be relatively little increase in amount of the disease. If these sanitary precautions were practiced from the beginning on new soils, the losses from drop would be kept down to a minimum. It is the custom on many lettuce farms to dump all diseased heads and culls into the drainage furrow where they are allowed to decay (Fig. 4). This is a bad practice, as it furnishes ideal conditions for the development and overwintering of the fungus. In some cases the diseased plants are not removed at all, but are allowed to remain scattered over the field and are later plowed under. It is difficult to control the disease by any methods as long as such practices are continued.

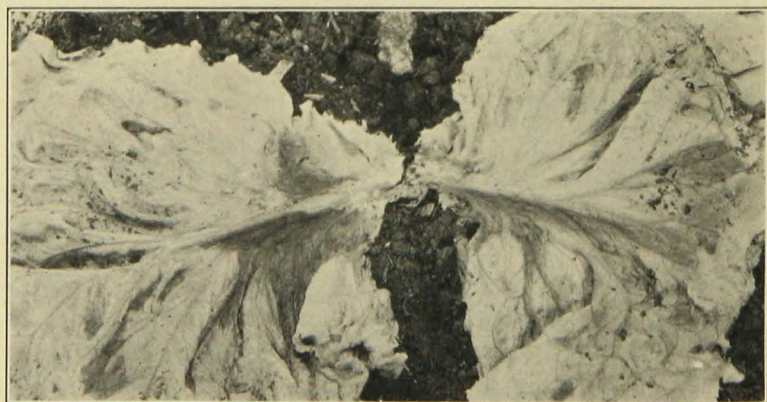
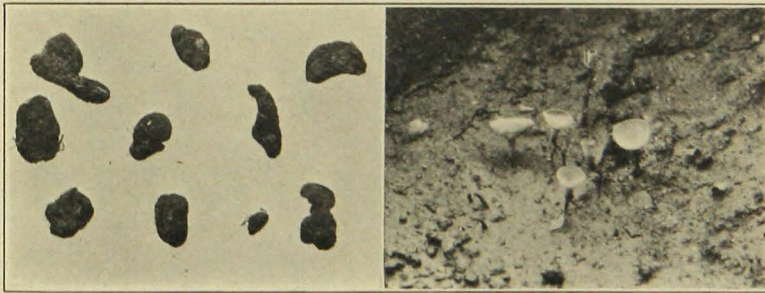


Fig. 2. Under Surface of Two Outer Leaves Removed from such a Plant as Is Shown in Fig 1

Observe the white fungous growth. Infection started at the base of these leaves where they were in contact with the moist soil.

Soil disinfection.—After the fungus has once become thoroly established in the soil, the only means of preventing loss is to disinfect the soil before planting. This is an expensive and laborious method, but on small areas where the disease is very destructive it may be profitable. The soil should be disinfected with a solution of formaldehyde made by diluting one gallon of commercial formaldehyde in one hundred gallons of water. This diluted solution should be applied to the soil at the rate of one gallon to each square foot. The application should be made at least two weeks before planting, in order that the formaldehyde may have time to evaporate from the soil. This method has given very good results in Pennsylvania.¹

Some experiments to determine the effectiveness of this method, as well as of other methods, were started in Minnesota in 1924, but on account of the very wet season the results were inconclusive. However, since the lettuce in the east is grown in much the same way as in Minnesota, it is very probable that the method would be effective here also. As the method is expensive, costing about \$2.50 per square rod, exclusive of labor, it can be recommended for use only on soils in which the disease is so firmly established that losses can be avoided in no other way.



(a)

(b)

Fig. 3.

(a) Sclerotia of the Fungus Causing Lettuce Drop

The fungus lives over winter in the form of these sclerotia which are produced in great abundance in the rotted remains of a diseased plant.

(b) Apothecia or Fruiting Cups of the Fungus growing from Sclerotia Which Have Remained in the Soil Over Winter

Thousands of spores are produced in these cups each spring and are blown about by the wind, thus spreading the disease over the fields. Diseased lettuce plants should be destroyed before the sclerotia are formed.

Seedbed disinfection.—It is not uncommon, when unsterilized soil is used in seedbeds, to have many of the young plants destroyed by "damping-off." This condition is usually due to the same fungi which destroy the older plants in the field. Not only are many plants destroyed in the seedbeds, but one of the most common means of

¹ Beach, W. S. The lettuce "drop" due to *Sclerotinia minor*. Penn. Agr. Exp. Sta. Bul. 165. 1921.

introducing the disease into new soil is by planting diseased plants taken from infested seedbeds. If young plants are grown in soil infested with the fungus, some of them are almost sure to become infected, and altho they may appear healthy they eventually become diseased and give the fungus a start in the new soil. This means of spread may be largely eliminated by growing seedlings in new soil, or better still, in soil that has been thoroly disinfected with formaldehyde. The method of disinfecting the seedbed with formaldehyde is the same as that given above. The soil in the seedbeds should always be sterilized and the cost is relatively small. Experiments have shown that many of the plants which developed the disease in the field were infected while yet in the seedbed. The disinfection of the seedbed soil is profitable, even if the field is not treated.



Fig. 4. A Field of Head Lettuce During Harvest

All diseased and decaying lettuce plants have been piled in the drainage furrow where they were allowed to decay. Such piles of refuse are breeding places of diseases. Sclerotia are formed in great abundance in the decaying plants, and millions of spores are produced which spread diseases the following spring. Such refuse should be removed from the fields and burned or soaked with a strong disinfectant, as copper sulfate solution.

Clean cultivation.—Whatever measures are taken to control the disease must be combined with good cultural practices. It has been pointed out that the disease infects more easily under very moist conditions. When weeds are allowed to develop about the plants, they hold the moisture and keep the surface soil about the plant wet, thus providing ideal conditions. Plants that are smothered by weeds are more likely to become diseased than those about which the surface of the soil is allowed to dry. Weeds also favor the development of the spores.

Crop Rotation.—Unfortunately, the fungus causing lettuce drop also causes a rot of many other plants, especially the succulent and leafy vegetables. It is therefore difficult to maintain a perfectly satisfactory rotation of crops. Many of the common vegetables, however, are only rarely affected under ordinary conditions. A number of common vegetables are listed below in order of their relative resistance to the disease:

- | | | |
|--------------|----------------|---------------------|
| 1. Peas | 5. Onions | 9. Carrots |
| 2. Beets | 6. Spinach | 10. Beans |
| 3. Radishes | 7. Cauliflower | 11. Chinese cabbage |
| 4. Rutabagas | 8. Cabbage | 12. Celery |
| | | 13. Lettuce |

Any except the last three could be safely used in a rotation, for they are all much more resistant than lettuce.

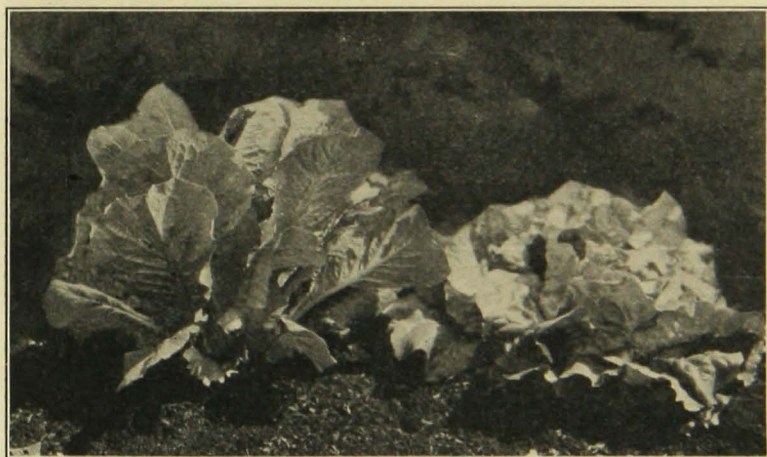


Fig. 5. A Plant of Romaine Lettuce on Left and One of Iceberg on Right

The Romaine type is not often affected by drop on account of its upright habit of growth, which permits the soil to dry out around the base of the plant. Leaves of the lower growing types, which lie flat on the ground, are very easily infected by the fungus.

Varietal resistance

Such varieties as Cos, or Romaine (Fig. 5), on account of their upright habit of growth, are not so seriously affected by drop as others. There is, however, not so great a demand on the market for this type of lettuce. Nevertheless, on soil badly infested with drop, it would probably be advisable to plant such varieties as part of the crop.

Gray Mold Another Destructive Disease

Gray mold is almost as destructive as drop, and under some conditions may be even more destructive. It is, however, more dependent

upon weather conditions than drop. The average grower does not distinguish this disease from drop, usually speaking of the two collectively as "rot." They are, however, quite distinct, and differ in several important respects.



Fig. 6. Head of Lettuce Affected with Gray Mold Rot

Notice that the outer leaves are not affected. Compare with Figures 1 and 2. Gray mold rot starts at the tip of the plant and advances downward. The outer leaves are usually the last to become affected.

Symptoms Seen in Marginal Leaf Decay

Plants affected with gray mold do not drop and wilt as suddenly as those affected with drop, but may eventually be just as completely destroyed. The decay frequently starts at the margins of the leaves and advances into the heart and stem instead of starting at the leaf bases and stem, as in drop (Figs. 6 and 7). In the moist places between the leaves, the fungus, known as *Botrytis sp.*, develops masses of gray spore-bearing mold. This gives the disease its name "gray mold."

Gray mold usually appears somewhat earlier in the season than drop, and is somewhat more dependent on rainy weather for its most rapid development. The disease is spread directly from plant to plant by means of the spores, which are easily blown about by wind. When a spore falls into a drop of water on a plant, it germinates and infects the plant directly. This fungus, like the one causing drop, will develop abundantly in the decaying rubbish from lettuce fields, but unlike the drop fungus, will produce great quantities of spores during the current season. Decayed culls from the early crop furnish ideal breeding places

for spores which infect the late crop. The destruction of diseased and culled plants is as important for the control of gray mold as for drop.

Control Lies in Sanitation and Rotation

On account of the abundance of wind-borne spores this disease can not be controlled effectively in the field by soil disinfection. Strict sanitation and rotation of crops are the only control methods known.

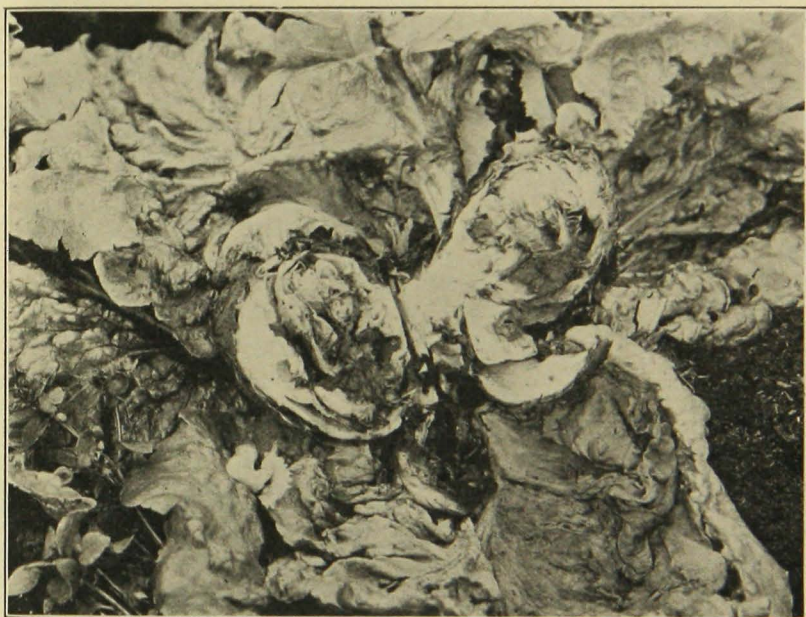


Fig. 7. The Same Plant Shown in Figure 6

The head has been split to show that the stem is still white and sound. The decay advances downward through the young center leaves.

Tip-Burn Does Much Damage

Much lettuce is injured by a condition known as tip-burn. The outstanding symptom of the disease is a browning of the outer margins of the inner leaves (Fig. 8). This condition often may extend for a considerable distance into the head, where it is not visible from the outside. Slightly affected plants frequently fail to develop firm heads and always have a bitter taste. Affected heads usually develop a slimy soft rot under favorable conditions. Plants affected with tip-burn appear to be more readily affected by gray mold than normal plants.

Tip-burn is a non-parasitic disease associated with moisture conditions. It develops most frequently when a period of hot dry weather follows a period of cloudy rainy weather. Soils that are inclined to

vary greatly in moisture content favor the development of the disease. Cultural practices which tend to keep a uniform moisture supply in the soil are the only control measures known. Heads affected with tip-burn should not be shipped, because in addition to having a bitter taste, they are more likely to decay in transit than normal ones.



Fig. 8. A Plant Affected with Tip-burn

The outer leaves have been pulled back to show that the "burning" is frequently more severe on the inside leaves than on the outer ones. The condition is due to rapid loss of water in hot dry weather. It is not caused by a parasite, but it makes the plants more susceptible to bacterial soft rots which may destroy the heads in transit.

Downy Mildew a Less Serious Disease

Downy mildew, as the name implies, is characterized by the white downy growth which develops over the leaves, chiefly on the lower surface. Affected leaves may be somewhat distorted; only the larger outer leaves are commonly affected. It usually does not occur abundantly until late in the summer and is associated with cloudy weather and high humidity. It is caused by a fungous parasite (*Peronospora lactucae*) which thrives best in such weather. The injury is hardly sufficient to justify special control measures. Sanitation, rotation of crops, and good cultivation should keep the disease in check.

"Shooting to Seed," a Hot Weather Effect

During periods of continued hot weather, lettuce which has begun to form heads will frequently send up a seed stalk at the expense of the head. In some years this is the source of enormous losses. As this condition is due primarily to weather conditions not under the control of man, very little can be done to prevent it. Lettuce which matures in the cool weather of late summer is rarely affected in this way.