Press Bulletin 66 September, 1928

# THE COLORADO EXPERIMENT STATION
FORT COLLINS

## ROOT ROT OF ALFALFA

By L. W. Durrell

Many fields of alfalfa thruout Colorado have been plowed up the past few years because of root rot. This disease is beyond doubt the most serious alfalfa disease in the state but its action is little understood. It is the purpose of this circular to briefly explain the way the disease affects the plant and to give some of the conditions responsible for the injury. Figure 1 shows a comparison of normal and diseased plants.

The stunting is accompanied by a wilting and flagging of the top which is most noticeable in the spring at the beginning of the growth or after the first cutting. The disease is progressive and increases in the plant with age. There is no connection between the wilt and the nematode disease found on alfalfa in some regions.

**The immediate cause** of the wilting and stunting is the lack of water, for the water tubes in the roots that carry the water

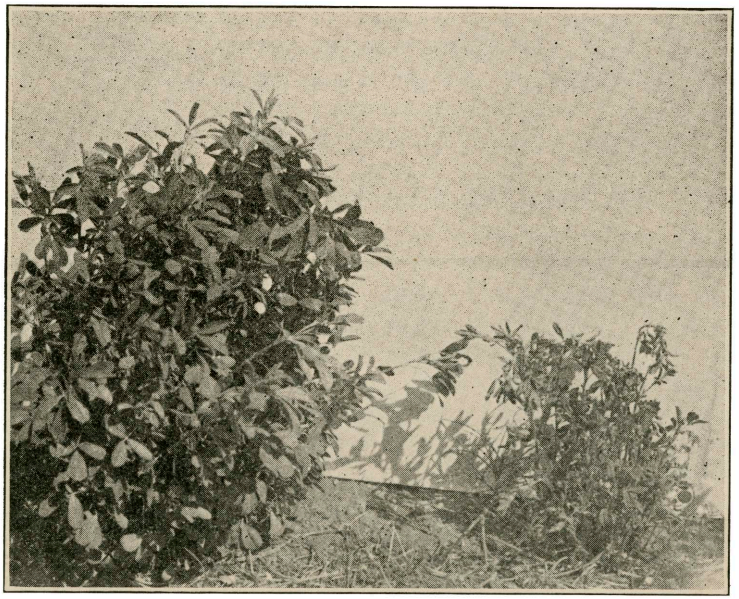

Fig. 1.—A normal alfalfa plant and a stunted, wilted plant with plugged water-conducting system.

to the leaves become plugged. On cutting the root near the crown, a ring of yellow or brown can be seen. Microscopic examination and chemical tests show that this browning or yellowing is due to a gum deposited in the water pores of the root, plugging them so effectively that little water can be carried up to the tops.

In the younger roots only a few scattered tubes are plugged but in the older roots so many are filled with the brown gum that they show as a colored ring or rings around the root, increasing with the age of the root and the progress of the disease. (Fig 2.)

The plugging of the water-conducting tubes of the root naturally results in reduced water flow to the leaves with accompanying wilting of the tops. The leaves in this condition are not able to make food and one of the important results of reduced water supply is reduced starch storage in the root. In normal roots large quantities of starch are stored with which to start growth in the spring. The diseased roots contain little starch and make poor growth in the spring or after cutting. These conditions, continued over several seasons, result in a progressive dying out of the plants in a field. Decay of the crown usually follows the above-described condition and rotted areas are found in older roots which extend deep down from the crown.

## Water Movement in Roots

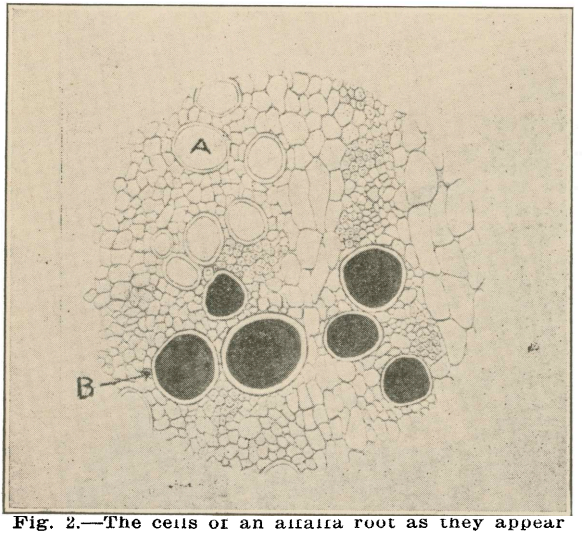


Fig. 2.—The cells of an alfalfa root as they appear when highly magnified.
A. Water-carrying tubes.
B. Water-carrying tubes plugged with gum so no water can go up to leaves.

Study of the structure of the alfalfa root shows that water is carried thru the root by special cells called ducts. These cells are short and joined end to end. The root is well supplied with these tubular cells extending from the ends of the roots to the crown. Dye drawn into the roots can be traced along these groups of

cells showing the course the water takes in the root.

In the young roots the tubes are of small bore but as the roots get older and the larger plant needs more water, larger ducts are developed. The young ends of old roots also have larger water-conducting tubes. In the diseased roots the water-conducting cells are filled with a yellow gum and water cannot pass. (Fig. 2.) Tests on the water flow in diseased and healthy roots show that on an average the plugged roots furnish the leaves about two-fifths less water than the healthy roots, and in badly diseased roots only about one-fourth of the normal water supply is carried to the leaves. It is of interest in this connection that the water ducts are generally smallest at the crown of the root and are hence more easily plugged there.

It appears from general observation that there is a relation between water supply to the alfalfa plant and root plugging and wilt. Plants growing in very wet areas are often especially diseased, also plants growing where the irrigation water enters the field, become affected. Frequeuntly fan-shaped dead areas occur where night runs have been made or where the water spreads out over the field as it leaves the irrigation ditch.

## Possible Causes of Root Rot

While the direct cause of alfalfa wilt is the plugged water-conducting cells in the roots, the cause of the production of the gum plugging these cells is obscure.

Some experimenters in other parts of the country attribute this gum formation to the action of a bacterial organism. Bacteria are of common occurrence in the root tissues of alfalfa and diseases of other plants are known where gum formation accompanies bacterial action. On the other hand, the presence of certain salts in cells are also known to produce gum.

Experiments conducted by the writer show that calcium sulphate, sodium nitrate, sodium carbonate, sodium chloride, potassium phosphate, sodium arsenate and mercuric chloride in dilute solutions when drawn into the roots produce gum in the water-conducting cells in a week to ten days.

In the case of mercuric chloride gum production is rapid and abundant. This salt is very toxic to bacteria and there is little possibility of bacterial organisms being the cause of gum formation in the roots in these experiments where mercuric chloride is present. The evidence points to the salt itself as responsible for the gum formation. Some of the salts present in soil or irrigation water have the ability to produce gumming in the cells of the alfalfa root. While bacteria in some cases may play a part in root rot of alfalfa, the action of salts in causing gumming and wilting, preclude bacteria from consideration as the sole cause.

## Possible Control Measures

The nature of the root disease of alfalfa makes treatment of any kind difficult if not impossible. No present method is known whereby the diseased plants can be cured. Shorter rotations have been suggested and there is hopeful possibilities in resistant varieties.

During the past few years Kansas seed has been in demand in Colorado and large quantities have been sold, doubtless because of good salesmanship rather than on merit. Our altitude and climate is considerably different from that of Kansas, however, and particularly from a Northern Colorado standpoint, Kansas seed should be classed as a southern seed. Seed from southern states is not adapted to northern Colorado and the State Seed Laboratory has definite evidence that such southern seed is being sold in Colorado mislabeled as Northern seed. It is highly probable that much of our root rot and dying of alfalfa is the result of the use of such seed not adapted to our region.