what the gardeners term second early. All this cabbage was planted in disease-infested soil, as is proven by the fact that 40 per cent of the Glory of Enkhuisen was destroyed by the yellows.

It would appear from these reports that the Marion Market is most suitable for markets demanding a small, solid head of cabbage. For kraut purposes, the Allhead Select may be more suitable, since it is larger and looser. The Iacope variety, while it is sufficiently resistant, does not seem to have the quality demanded by the gardeners. It tends to large, flat heads and looseness of texture that is often undesirable in market varieties. It is apparent, too, that resistance seems to be linked with lateness, at least none of these varieties are as early as the parent type. However, this fact is not sufficient to condemn the varieties, since they do possess a remarkable resistance to the yellows and will produce large crops on badly infested soil.

For the late varieties, the Wisconsin All-Seasons, Wisconsin Succession, Wisconsin Hollander and the Indiana still retain their place in the lead. The Bugner variety developed at Chicago has not proven acceptable. Where it has been grown the plants are large, the leaves are coarse and too often it fails to produce a head, but still it is resistant.

CONTROLLING TOMATO LEAF MOLD IN GREENHOUSES IN INDIANA.

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One of the most serious diseases of tomatoes in greenhouses in Indiana is the tomato leaf mold (fig. 1). It is not universally present but where it does occur it usually kills all the leaves and the plants appear as if swept by fire (fig. 2). Commonly the disease does not become serious until after the second or third clusters have been harvested. At this time every leaf except a few at the top of the plant

Fig. 1—Tomato leaf mold symptoms.

is infected. The upper tomatoes are consequently smaller and must ripen on the defoliated stalks. They lack both in size and quality.

Not only are the leaves destroyed but frequently the fungus attacks the calyces and rots the stem end of the fruit. This has been described by Gardner.[1]

Proper ventilation of the houses has proven to be an important factor in controlling this disease. It would seem, then, that the prevention of leaf mold is largely a matter of greenhouse management and the disease would probably be worse in the poorly managed houses. This, however, is not true, since leaf mold is a serious pest in certain of the best greenhouses in the state. And in some of the conspicuously poorer houses it seldom if ever occurs. There is no question that improper ventilation and the consequent accumulation of moisture is a factor in increasing the disease, but it is equally certain that continual appearance of the disease and the concomitant accumulation of inoculum plays an important part.

Fig. 2—Leaf mold destroys every leaf on the plant and gives the appearance of the plants having been swept by fire.

The importance of spore accumulation in various parts of the greenhouses was well demonstrated by Emmett Wood, at Madison, Indiana. Wood fastens his tomato plants on three horizontal wires, which are strung lengthwise across the beds. The vines are tied to these wires with binder twine. The plants were badly infected with *Cladosporium* and it seemed probable that the spores would accumulate on the strings. With this possibility in mind, Wood poured gasoline over the spools of wire and burned off all the knots. The next season the leaf mold was

[1] Gardner, M. W. Cladosporium Leaf Mold of Tomato: Fruit Invasion and Seed Transmission. Jour. Agr. Res. 31:519-540, 1925.

retarded in its appearance in the houses where the string had been burned from the wire. It was as severe as ever in the beds where the knots had been left. It is possible that the spores spread from the infected bed to other parts of the house.

To determine if the spores of *Cladosporium fulvum* could be carried on the strings, the following experiment was conducted: Tomato plants grown in the Purdue Botany greenhouses were trained on strings which had supported plants heavily infected with leaf mold the previous season. Other plants were also trained on new strings. A month after the experiment was started a few spots of leaf mold developed on the plants trained on the strings from the infected greenhouses. No spots developed on the check plants. At this time white fly became so serious that the experiment was discontinued. Though the experiment was not complete, still it indicates that the spores of *C. fulvum* can be carried on the strings used to support the diseased vines.

Hasper[2] has shown that the conidia of this fungus can live eight months under dry conditions. This is sufficient longevity to permit it to exist from one crop to another in greenhouses. This evidence has been deemed sufficient to recommend to greenhouse gardeners that they discontinue the rather common practice of using the same strings year after year to support their vines. The majority are now using new binder twine each year.

Experiments have rather discouraged the use of dusts or sprays in the greenhouse as a means of control and have emphasized the need of proper ventilation. Three years ago Emmett Wood sprayed his greenhouse tomatoes under our direction. To avoid staining the fruit he used a 2-3-100 soda bordeaux.[3] It was applied at a pressure of 300 pounds. A long hose was used, permitting the operator to walk the length of each house between the vines. A short rod with an angle nozzle was used so that the spray was applied on the lower surfaces of the leaves without difficulty.

The first application was made on May 9, 1924, when the plants were between three and four feet tall. At this time there were no signs of the leaf mold. The spraying did not entirely eliminate the disease but it was held in check sufficiently so that the vines remained green until the crop was completely harvested. Wood's statement concerning this work was: "Spraying greenhouse tomatoes has added not less than $500 to our sales this year."

But there are many places where the gardeners are not equipped with power sprayers and it has been shown that thorough spraying cannot be done with a hand outfit. For these men, another method must be used, and to meet this condition dusting with 25 per cent copper-lime dust was used. The tests were carried out by Kiesling Bros. at Logansport, Geo. Wade at Muncie and Joe Shane at Fairmount.

Kiesling Bros. used an American Beauty knapsack duster and applied the dust five times during the season, beginning when the plants were about three feet tall. The leaves were well covered on the upper

[2] Hasper. Biologic and Bekampfung des *Cladosporium fulvum* Cooke auf Solanum lycopersicum. Ztschr. fur Pflanzenkr. 35:112-118, 1925.

[3] Two pounds copper sulphate, three pounds sal soda, one hundred gallons water.

surfaces but it was difficult to thoroughly cover the lower surfaces. Nevertheless, the disease was held in check, only appearing late at one end of a single house. The chief difficulty experienced by the growers was that the fruit was heavily covered with the dust and each tomato had to be wiped off before marketing.

Geo. Wade used a different type of duster that did not deliver the dust in sufficient quantities, nor could the dust be directed against the lower surfaces of the leaves as efficiently. In this case the disease was not held in check to any appreciable extent.

Joe Shane did not start his applications until the plants had developed five or six clusters of fruit. The leaves were heavily spotted with the disease at the time. However, by the use of the American Beauty duster, he managed to prevent the destruction of the upper leaves and ripen his crop properly.

This evidence indicates that neither copper-lime dust nor soda-bordeaux will absolutely control leaf mold but the use of either of these materials is economical. They retard the disease sufficiently to permit the proper ripening of the tomatoes. It is also true that both the dust and the spray must be applied thoroughly and with the proper apparatus. The duster must deliver a sufficient quantity of dust to completely fill the house. The spray must be applied with at least 200 pounds pressure. In either case care must be exercised to direct the spray or dust against the lower surfaces of the leaves.

EXCESS SOLUBLE SALTS AS THE CAUSE OF VEGETABLE DISEASES IN GREENHOUSES.

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In many greenhouses of Indiana, lettuce, grown in ground beds, is often affected in a peculiar manner. The growth is stunted and though the plants remain in the soil for ten weeks or more they never attain more than one-third to one-half the normal size. Ordinarily they do not die but simply stand still, though in a few instances lettuce plants have died. Under similar conditions, tomato and cucumber plants are also affected in the same way.

Lettuce plants have been examined in scores of cases. The leaves are small, usually dark green and very tough. The roots are brown, the tips usually being killed, and their development sparse (fig. 1). Nematodes are not associated with this trouble and as a matter of fact nematodes do not cause any serious injury to lettuce though they may kill tomatoes and cucumbers.

The roots, the stems and leaves of these diseased plants have been examined repeatedly and thoroughly, but no fungus or bacterial pathogen has been found associated with them.

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