Some Large Botanical Problems.

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Every farmer, without doubt, desires to produce bumper crops. As agriculture is one of the large factors in national prosperity, it is to the interest of every person in whatever walk of life that bumper crops should be produced. The Experiment Station in each State has been established to assist the cultivator, whether farmer, orchardist, gardener, or any other grower, to solve the problems that hinder maximum production. Some of the problems fall naturally to the botanist. It is well to review them, and not only recognize where the problems lie, but have some idea of their importance. As there are plenty of urgent botanical problems in the home State, it will not be necessary to go outside of Indiana to find illustrative material.

Probably the associated problems that give greatest concern to the cultivator, but which are obscure and little understood, and therefore much in need of study, are the plant diseases which most botanists believe to be connected with soil sanitation. Often they occasion great loss in a crop without the cause being apparent. The soil seems to be all right and proper cultivation has been given, but the plants fail to make their best growth or even dwindle and die. Reference is made to a variety of diseases caused by minute fungi or bacteria, and which attack various garden, truck and field crops. Some instances may be cited without pretending to give them in the order of their importance.

Soil Fungi Attacking Vegetables.—A conspicuous set of diseases, given the name of wilt, is due to certain fungi or bacteria, in which the plants develop normally and may even be bearing, when within a few days they wilt and die as completely as if the roots had been severed. The wilt of watermelons, usually due to a species of *Fusarium*, and of cantaloupes, more often due to bacteria, has often carried off a large part or even all of these crops, so extensively grown in the southern half of the State. The same or similar diseases extend to cucumbers, squashes, and other cucurbits. The partial remedies so far used are rotation of crops and disease-resistant varieties. The germs in certain cases are known to have remained in the soil in viable condition for eight years without a suitable host in the meantime, and the extent to which rotation of crops serves to check the disease is yet uncertain. The disease-resistant varieties of melon so far provided do not equal the others in flavor, so say our Indiana growers, and are consequently not much used. It is, therefore, still a large problem for the plant pathologist to find means for protecting the melon crop and others of like nature from the attack of such destructive germs.

A similar disease of the tomato has been very injurious at times in Indiana. Mr. W. H. Dyer of Vincennes reports a loss during the one season of 1913 of 6,000 bushels of fruit, some thirty acres of his field being entirely destroyed by the *Fusarium* wilt. Other soil diseases, like leaf spot, fruit rot, etc., also prove destructive at times.

Some of the leaf diseases of potato may be checked by spraying with Bordeaux mixture, while for scab on the tubers a serviceable and practical remedy is known in formaldehyde, showing that some good work has been accomplished along this line. But there are a number of other diseases, often causing heavy loss, that are little understood, and whose method of control is yet to be discovered. Mr. W. A. Orton of the United States Department of Agriculture stated recently before the Wisconsin Potato Growers' Association that six million dollars were lost to the country during the present year of 1914 from potato diseases.

There are a number of damping-off diseases to be classed here. They attack the young plants and cause them to die before becoming established. In the field the disease will spread from plant to plant over large areas. One season a field of beets was reported as largely destroyed in this way. But it is in cutting beds and seed beds under glass where such rayages are most marked.

The growing of vegetables under glass has become a large industry in Indiana. It is a kind of intensive culture where every individual plant bears an important relation to the final profits. Complaints are frequently received of losses in the cucumber and lettuce crops, which prove to be due to the inroads of the fungus, *Sclerotinia libertiana*, sometimes called lettuce-drop.

These diseases, and many similar ones are believed to be harbored in the soil from year to year, and in some cases to be carried from crop to crop by the seed, and possibly by other yet undetected means. How many kinds of germs are concerned in such diseases is not yet known.

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They are certainly bewilderingly numerous. The study of any one of them requires much research, and in no case has such a study been fully curried out. Two remedial methods are especially advocated, rotation of crops, and the breeding of disease-resistant varieties. Neither of these methods is yet much or substantially developed. The disinfection of seed and direct destruction of the germs in the soil have yet scarcely been tried out. Spraying of the crop may be found in some cases to serve a good purpose, but so far not much help has been secured in this direction.

Soil Fungi Attacking Forage Crops.—A soil disease, which may become a serious enemy of the alfalfa crop, has been reported from a number of places during the past season. In Clark County, in the southeastern part of the State, eighteen fields were examined during an alfalfa tour, and every one, as reported by Mr. Hutchins, the county agent, was found infested with *Sclerotinia trifoliorum*, a fungus much to be dreaded, that sometimes attacks clover as well. As alfalfa culture is just in its beginning in this State the disease presents an important problem. A banker from another part of the State in writing to the Experiment Station regarding his experience with this disease said in substance: I always thought that the three sure things in this world were death, taxes and alfalfa, but I am afraid that I must leave out alfalfa, possibly quit growing it, on account of the disease.

Other root diseases caused by *Fnsarium*, *Rhizoctonia* and *Ozonium*, as well as less severe leaf diseases, are known to damage the alfalfa crop, and may be expected to increase, unless measures are taken to hold them in check. Outside a rotation of crops little has yet been suggested by way of control for any of these pests.

Soil Fungi Attacking Grain.—In seeking the cause why grain, especially wheat, does not yield as well as it once did, and as everyone believes it should continue to do, there is no longer any doubt that much stress should be laid upon soil fungi, especially species of Fusarium, Macrosporium, Alternaria, Helminthosporium and Colletotrichum. These fungi, sometimes one of them at a time, sometimes more than one, attack the roots of the grain, and work their way into the upper parts of the plant, the stem, leaves and heads. If the attack is light the grain is somewhat less vigorous than it otherwise would be, and the harvest correspondingly lighter, but there is no appearance of disease. Fusarium sometimes becomes so active that it causes what is called scab, or pink mold, and the head of wheat is a total loss, but the soil is usually not suspected as the source of the trouble.

When grain is grown continuously on the same fields the soil tends to accumulate germs of this character. Such an infested soil may be likened to a house long used by sick people without cleaning. What is needed is a thorough disinfection. Unfortunately, at present we know no satisfactory way of disinfecting soils, and we do not even know the kinds and virulence of the diseases to any extent. Our chief reliance so far has been in crop rotation. Possibly something might be done by disinfecting the seed, which is known to harbor the germs. Mr. Hoffer found, as reported in last year's Proceedings of this Academy, that out of thirtyfour varieties of wheat examined by him twenty showed germs of this sort, most of them being *Fusarium*.

The subject is a large one of the highest economic importance, and in very great need of study.

Diseases Not Associated With the Soil.—There is no need of specifying where work is needed in this class of troubles, the subject has been before the public too long. Many such diseases are now well understood and efficient remedies already put into use, as in the case of oat and wheat smut, corn smut, and some fruit rots. But there are many rusts, mildews and blights yet to be worked out, and their economic importance rated.

Weeds.-As a rule weeds have not been regarded with sufficient seriousness. But many farmers appreciate the advantages of clean culture, and would like to exterminate the more pernicious kinds. There is a group of weeds, including especially the bindweeds, wild sweet potato, horse nettle and trumpet creeper, that need careful investigation as to the best methods for their control. Field experiments along this line are needed. Horse nettle is now infesting thousands of acres of land in the southern and central parts of the State and is gradually gaining ground northward. Trumpet creeper is becoming so pestiferous on account of its heavy. woody roots, as to make the work of cultivating the infested lard a diffi ult and tedious task. Bindweeds and wild sweet potato are proving to be a bane to corn culture, especially on bottom lands. Large fields can be found where nearly every corn plant is entwined by some one of these kinds of weeds. It is safe to say that in such cases the crop yield is reduced by at least one-third. Aside from reducing the yield such weeds also increase the cost of field operations and harvesting and in other ways depreciate the value of land.

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It is quite possible that suitable investigation would produce as marked and practical results in the case of most of these weeds, as has been reached in the recent study of the wild garlic situation in southern Indiana. An intensive study of this weed has resulted in a special method of eradication that promises to be a boon to owners of land where garlic has been established, and to render its complete extermination entirely feasible.

Poisonous Plants and Molds.—The subject of plants and molds, which are or may be poisonous to stock needs careful investigation. Many plants and various molds have been suspected of poisonous action of which there is little definite knowledge available. In the majority of cases the evidence is based on reports obtained from farmers, with no scientific investigation or actual tests to support them.

The botanical department of the Experiment Station often receives letters, with specimens of plants, stating that those particular kinds of plants are believed to have been responsible for the death of several head of stock, usually cattle. It is known that some of the wild larkspurs of the State are poisonous, and that loss of stock has been due to them, but no very exact information is at hand.

Certain silage molds have been under suspicion, and moldy corn is quite definitely known to act in a poisonous way.

The importance of careful study of authenticated cases of poisoning from the botanical standpoint will not be gainsaid.

Conclusion.—Probably enough has been said by way of citing examples, and pointing out lines of work to show that there is much valuable investigation for the benefit of the cultivator that falls naturally to the trained botanist. Most such work must be done by the technical man who is supplied with suitable equipment. That the State should properly provide the means for carrying forward work of this character seems to require no argument.

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