PESTS AND DISEASES.

MYCOLOGICAL NOTES.

FURTHER OCCURRENCES OF *RHIZOCTONIA BATATICOLA* (Taub.) Butler.

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These notes are arranged under the headings of the various host plants of the *Rhizoctonia*. Certain of the hosts have been reported previously (1), but new facts regarding the *Rhizoctonia* have come to light. Other hosts are new records for Ceylon.

(1) **Tea.**—It was mentioned in the October Mycological Notes that *Rhizoctonia bataticola* had been found to occur on tea along with *Diplodia*, *Fomes lamaoensis* (the fungus of brown root disease), *Fomes lucidus*, *Rosellinia*, *Ustulina* and *Polyporus interruptus*, and that it had not been found in association with *Poria*. Lately, however, several cases have been encountered in which the *Rhizoctonia* and *Poria* are in association, and *Poria* may be added now to the list of fungi which occur on tea along with the *Rhizoctonia*. In the majority of cases of tea root disease in which another fungus accompanies the *Rhizoctonia*, the latter is much less conspicuous than the fungus accompanying it, and the specimens therefore have to be examined with care in order that all the factors present may be taken into account. *Rhizoctonia bataticola* has been found also to be present in further cases of apparent brown root disease and *Diplodia*.

Several cases of deaths of young tea in new clearings have been examined recently. They may be divided into three classes: (a) specimens in which *Rhizoctonia bataticola* occurs alone and which show no collar-rot, (b) those in which the *Rhizoctonia* is accompanied by *Poria* and which also have no collar-rot, and (c) those which may be called clear cases of collar-rot. The deaths of the plants placed in (a) and (b) are due solely to fungus attack. The exact causes of the collar-rot of (c), however, are not known, nor is it clear that the actual rot of the collar tissues is closely connected with the cause of death. The outstanding indication of collar-rot is a ringing of an inch or two of the stem to the wood at ground level; in many cases the area from which the bark and cortex are missing is bordered above and below by a protruding growth of callus from the uninjured cortical tissues. The recent cases of collar-rot did not show the constricted and blackened stem described by Petch and attributed by him to fungus attack (2), and there may therefore be more than one type of collar-rot and more than one cause of it. In Ceylon, *Rhizoctonia bataticola* may be one of the causes, for the fungus has been found in both roots and stems of several recent collar-rot specimens, but other examples of collar-rot seem to have no connection with fungus attack. It is probable, therefore, that collar-rot is due at times to other than fungus agency. It may be, for example, the work of insects, and it has also been attributed primarily to mechanical injury due to wind friction or

overheating of the surface of the soil. With regard to the suggestion of an insect cause, Petch has stated that the ultimate death of the plants involves the presence of a fungus parasite, but it should be noted on the other hand that the girdling of the stems of young coffee plants at the surface of the soil by "cutworms" in Tropical Africa leads to the death of many of the affected plants without the intervention of a fungus parasite. The writer is informed that certain cockchafer grubs (*Lepidiota* and *Anomala* spp.) and an ant (*Dorylus orientalis* Westw.) are suspected of causing a ringing of young tea stems which might pass into the condition known as collar-rot, and the relation of these insects to young tea is perhaps worthy of investigation.

(2) **Citrus.**—A large plot of lime trees (*C.medica* L.var. *acida*) at the Anuradhapura Experiment Station is affected by a general die-back or wither-tip of the branches and by a gumming of the stems. Both of these pathological conditions have been reported from citrus-growing countries, and the former of them has been attributed to a definite cause in Florida, namely, attack of *Colletotrichum gloeosporioides*. The latter, again, has been attributed to certain fungi in the case of the lime. It has been found that the wither-tip material from Anuradhapura will yield a species of *Colletotrichum* and also *Diplodia*, and that the stem gumming is accompanied by a bacterium. The wither-tip fungi have not been tested in inoculation experiments, but tests of the pathogenicity of the stem bacterium have proved it to be incapable of infecting or affecting in any way either citrus leaves or stems.

Meanwhile, examination of the roots of Anuradhapura limes has disclosed the presence of *Rhizoctonia bataticola* on the roots of sickly trees, and it therefore is possible that the root fungus is the basic cause of the local wither-tip or die-back and gumming of citrus and that the fungi and bacteria associated with these conditions are mere saprophytes. Orange trees are affected in the same way as limes, but only a few orange roots have been examined and the *Rhizoctonia* has not yet been found upon them. The writer is confident, however, that the disease of both lime and orange trees is due to one cause. Further, it will cause no surprise if *Rhizoctonia* disease of citrus is found to be wide-spread in Ceylon. *Ustulina* and *Diplodia* occur on occasional roots of lime trees attacked by the *Rhizoctonia*.

(3) **Cacao.**—Since the report of *Rhizoctonia bataticola* as a cause of cacao root disease in Ceylon, two consignments consisting of fifteen diseased stumps from the Experiment Station, Peradeniya, have been examined. Typical symptoms of *Rhizoctonia* attack were found on every specimen, and the fungus itself on a large proportion of them, namely, those which had the smaller roots *in situ*. As before, other fungi were present at times, particularly a *Rosellinia* which grows between the bark and wood of both the stem and the upper part of the tap-root and a *Nectria* which occurs on the bark of the stems.

(4) **Hevea brasiliensis.**—In recent cases of *Hevea* root disease, *Rhizoctonia bataticola* has been associated with the fungus of brown root disease (*Fomes lamaoensis*), with both *Ustulina* and *Sphaerostilbe*, and with *Fomes lignosus*, *F. lamaoensis* and *Poria*. In the second case, the penetration of the *Rhizoctonia* was very complete, large numbers of its sclerotia being found in the wood of a root which was attacked externally by *Ustulina*

and *Sphaerostilbe*. Curiously enough, the tree from which the root was taken appears to be healthy, and it will be interesting to note future developments. The last case is of particular interest because the three fungi mentioned, *Poria* and the two species of *Fomes*, occurred on different roots of a single tree which had been attacked by the *Rhizoctonia*. All its smaller roots and many of the larger were full of the sclerotia and black lines of the fungus.

(5) **Chillies.**—*Rhizoctonia bataticola* has been reported as a root parasite of chillies in the North-Western Division. In a recent case from the Experiment Station, Peradeniya, the *Rhizoctonia* on the roots was accompanied by certain pathological conditions of the aerial parts of the plants, namely, a die-back of the branches with which was associated a species of *Vermicularia*, a pod anthracnose with which was associated a *Gloeosporium*, and an *Oidium* leaf mildew. It is unnecessary to enlarge in these Notes upon the possible significance of the co-occurrence of those root, stem, pod and leaf fungi of chillies, but one result of the discovery of the *Rhizoctonia* under those circumstances is to indicate that an examination which does not include an inspection of the condition of the roots of the plant may be incomplete. It ought to be carried beyond the disease that is evident, for example, pod anthracnose, lest it lead to a wrong conclusion. It is not asserted that every case of die-back or pod anthracnose is accompanied by or due primarily to the presence of a root fungus, but it is asserted that it is necessary to examine the roots as well as the upper parts of diseased plants. This remark applies to other plants as well as to chillies.

(6) **Hakgala Botanic Garden Trees.**—*Rhizoctonia bataticola* has attacked and proved fatal to examples of *Acacia elata* A. Cunn. (Mountain Hickory), *Tristania conferta* R. Br. (Queensland Box) and *Cupressus macrocarpa* Hartw. (Monterey Cypress) at Hakgala. All three hosts are introduced species. *Cupressus macrocarpa* was a victim of the *Rhizoctonia* in Uganda, and root disease of the *Acacia* is accompanied by stem gumming as in *Acacia decurrens*. The three trees were growing at distances of about fifty yards from each other so that the different infections must have taken place independently. In each case, the smaller roots and some of the larger were remarkable for the numbers of sclerotia of the fungus.

The data derived from the continued examination of cases of root disease, particularly those examined carefully in the field, lead to the conclusion that *Rhizoctonia bataticola* is present either singly or in company of another fungus or fungi in a greater percentage of cases than was suspected. The many cases of root disease of tea, rubber, cacao and other plants that have been examined in the last six months may be divided into three classes; (a) those in which *Rhizoctonia bataticola* is present alone, (b) those in which the *Rhizoctonia* is accompanied by another fungus or fungi, for example, the cases of tea and *Hevea* root disease mentioned in these Notes, and (c) those which appear to be due to other fungi because no *Rhizoctonia* appears to be present. Regarding the first class it may be said that *Rhizoctonia bataticola* is solely responsible for the deaths of the affected plants and that the cases of this class number more than fifty per cent. of the total number of cases. The cases of (b) become a question of the succession of fungi, that is, of the priority of one form over the others present. In order to allocate responsibility for root disease in such cases, one fungus must be shown to

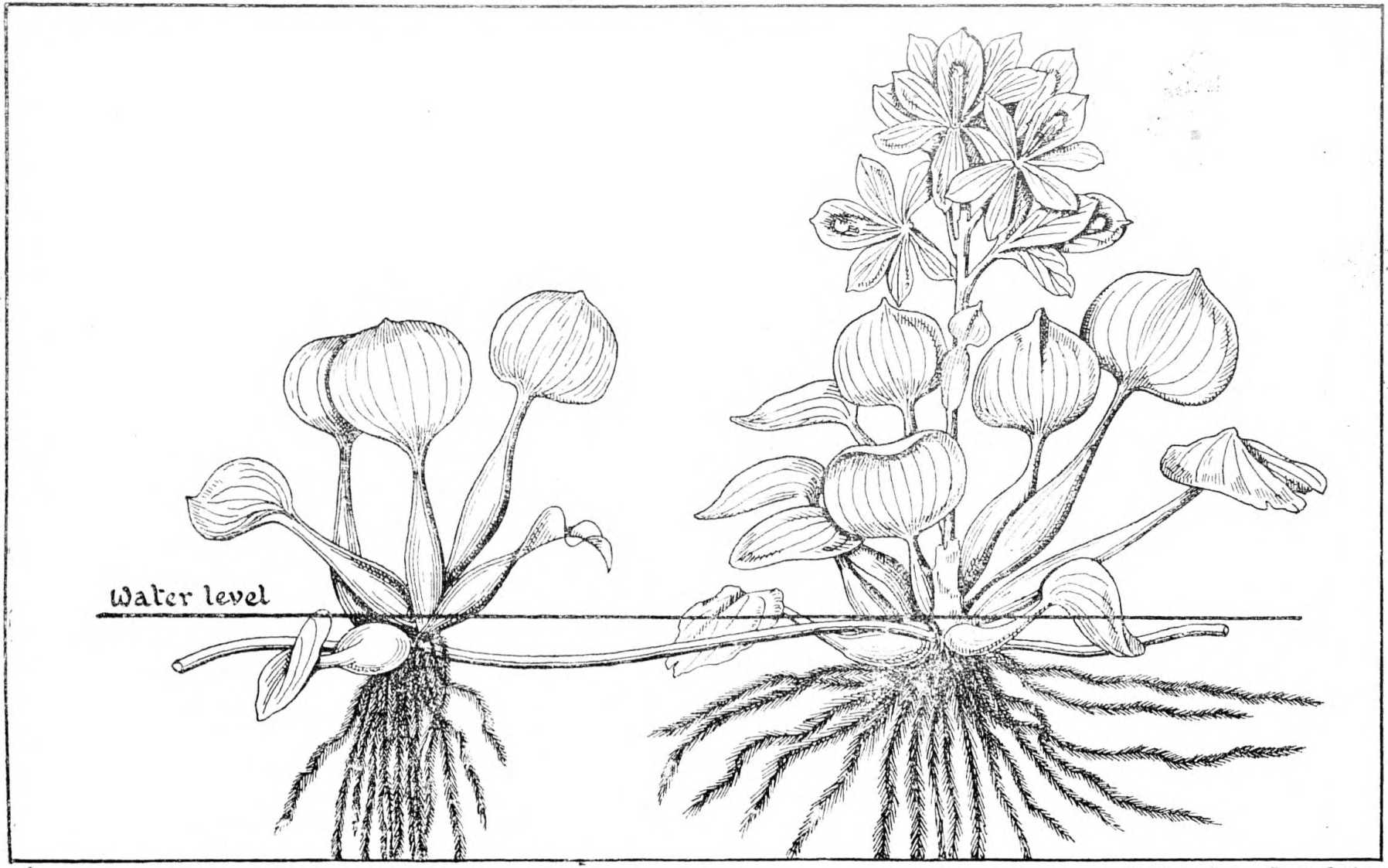
have attacked before the other. A certain amount of evidence which points to the priority of *Rhizoctonia* over fungi like *Poria*, *Fomes* and *Ustulina* has been acquired, and it is hoped that the inoculation experiments in progress will shed additional light on the point. The specimens of class (c) appear to be clear cases of, say, *Poria* or *Fomes* or *Ustulina* disease at first sight, but it is found that the symptoms of *Rhizoctonia* attack (particularly the hard dry condition induced in the wood of invaded roots) are also present although the *Rhizoctonia* itself may not be found in the form of sclerotia or " black lines." This latter condition has aroused a certain suspicion and has led the writer to make special field investigations and to have material dug and collected in accordance with special instructions, and it has been found in every case to date that the *Rhizoctonia* is present in addition to the more easily seen fungus which was supposed to be the only fungus at work. Investigation is being continued on these lines. In the meantime, it can be said that cases of (c) type of root disease are becoming more and more scarce; in other words, the (c) class is being merged into (b) and is disappearing gradually. As has been said, the *Rhizoctonia* is present more often than was suspected.

There is therefore more need than before for a determination of the status of *Rhizoctonia bataticola*. In connection with that remark, it may be pointed out that the parasitic status of fungi like *Fomes* and *Poria* is based on their supposed sole association with root diseases rather than upon experimental proof of their parasitism, and that there is therefore as much need for a determination of their status as for an investigation into that of *Rhizoctonia*. The fact that they are accompanied frequently, if not always, by *Rhizoctonia bataticola* calls for enquiry into their capabilities for parasitism, if it does not justify scepticism of their parasitism, for the *Rhizoctonia* is at least as worthy of blame for root disease as the older-established fungi like *Poria* and *Fomes*. It is not overlooked that the *Rhizoctonia* may be a common soil saprophyte which is able to enter only dead and dying tissues, but it is just as probable that *Fomes* and *Poria* are common soil saprophytes which can attack only dead and dying plants killed or weakened by the *Rhizoctonia*. It may be repeated that the *Rhizoctonia* is more consistently present than the other fungi and that it can be found to be the sole cause of root disease and death in more than fifty per cent. of the total number of cases examined recently. As the relative responsibility of the various fungi can be settled best by experiment, a large number of inoculations with *Rhizoctonia* and the other fungi has been performed.

REFERENCES.

(1) Tropical Agriculturist, LXVII., Nos. 2 and 4, August and October, 1926.

(2) Diseases of the Tea Bush, p. 119.



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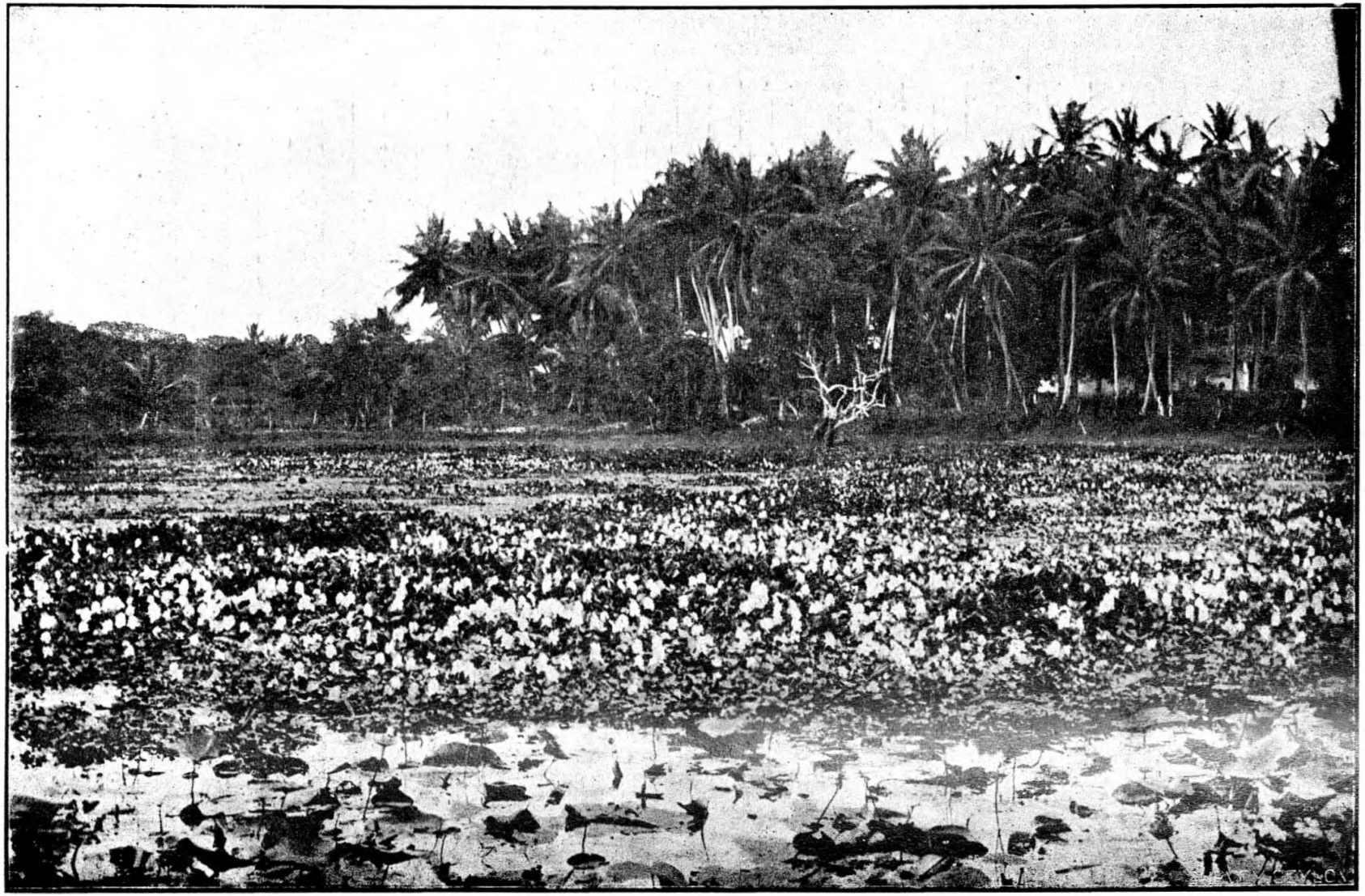
WATER HYACINTH SHOWING ROOT SYSTEM AND METHOD OF VEGETATIVE PROPAGATION.

(Adapted from Illustrations in Journal of the Department of Agriculture, South Africa.)



WATER HYACINTH IN FLOWER.
Maha-wewa in the Weeraketiya-Walasmulla Area.