Entomological Investigations on the Spike-Disease of Sandal.

Indian Forest Records. Entomology Series. Published by the Government of India. 1932-33.

THIS is a valuable series of entomological papers issued in connection with the investigation of the entomological aspects of the spike-disease of the Sandal tree (*Santalum album*) in South India carried out by the Forest Research Institute, Dehra Dun, on behalf of the Forest Departments of Madras and Coorg in South India. The results of this investigation on sandal entomology which occupied a period of over three years from 1930 have been published in parts and so far twenty-four parts have appeared in the *Indian Forest Records* Series. Of these twenty-four papers, No. 1, part of No. 2 and No. 20 give us an idea of the history and genesis of the main problem of sandal spike-disease, the programme of investigation, the progress of the work and the final results of the investigation of the main problem of the relation of insects to the sandal tree and the part they might play as vectors of the spike-disease. The other numbers—twenty-one parts in all—deal chiefly with the systematics and bionomics of the different groups of insects collected from sandal and are papers prepared by specialists to whom the different groups of insects were submitted.

In the first number of the series, Dover gives an account of the whole problem of the sandal spike including the history of the disease, early spike investigations and their results and discusses the different possible methods of transmission of the disease and lays stress on the likely transmission of the spike-disease by insects, especially by sucking forms and the economic importance, therefore, of intensive studies on the insect fauna of the sandal areas of Salem and Coorg. In the first part of the second paper Dr. Beeson gives a short account of the genesis of this insect survey idea, describes the organisation for research on the entomological aspects of the disease and adds some remarks on the transmission experiments started in connection with it in Salem and Bangalore. In Dr. Beeson's words "The faunistic survey had as its primary objective a determination of the constitution of the sandal insect association and the regional distribution of its component species."

The other papers include studies on special groups by well-known specialists. The groups studied so far include (*a*) *Beetles* of the families *Cicindelidæ* (by Horn and Chatterjee), *Coccinellidæ* (Korschefsky), *Bostrychidæ*, *Platypodidæ* and *Scolytidæ* (Beeson), *Anthicidæ* (Heberdey), *Lycidæ* and *Brenthidæ* (Kleine), *Anthribidæ* (Jordon), *Carabidæ* (Andrewes), *Melasidæ* and *Elateridæ* (Ftentiaux), *Crambycidæ* (Fisher); (*b*) *Neuroptera* (Banks); (*c*) *Thysanoptera* (Ramakrishna Ayyar); (*d*) *Formicidæ* (Mukerji); (*e*) *Rhynchota* families—*Jassidæ* (Pruthi), *Cercopidæ* (Lallemand), *Membracidæ* (Funkhouser) and *Pentatomidæ* and *Fulgoridæ* (Chatterjee). An examination of the forms noted in these systematic papers shows a very interesting and unusual record of about 500 species of insects found on this single tree *Sandal*. Of this number, 79 forms appear to be new to science including a few new genera. Greater attention, however, appears to have been paid to the groups of sucking insects especially the homopterous families *Jassidæ* and *Fulgoridæ*, and in the series we find special monographs on the life-history and morphology of three insects—the Jassid *Petalocephala nigrilinea*, W. and the two Fulgorids *Sarima nigroclypeata*, M. and *Eurybrachys tomentosa*, F.—all by Mr. N. C. Chatterjee. The reason for the special attention paid to these three insects appears to be that these were found fairly common and injurious to sandal and were considered as probable vectors of the spike-disease. These three papers recording intensive studies on the different aspects of individual insects are extremely interesting and useful and have added to our knowledge of these bugs in many ways, as for example, in the case of two of these insects, *viz.*, *Petalocephala* and *Eurybrachys* it has been found by breeding that three described species of each of them are after all the two sexes of one of the same species! In addition, these intensive studies on particular species as types give hemipterists a general view of the life-history and bionomics of the family as a whole—a feature which is of great importance to future workers in this line. As a result of these studies on Homoptera the jassid *Moonia albimaculata* was pitched upon as the most probable vector of the spike-disease and in paper No. 20 of the series, Dover gives an account of the different series of trials such as mass infection

experiments, group experiments and specific vector experiments explaining the methods adopted and the insects utilised; he also adduces different kinds of evidences to incriminate the insect *Moonia albimaculata* as the possible vector of the disease and finally summarises the results of the experiments conducted so far by stating (1) that field investigations and biological analyses strongly support the theory that spike-disease is transmitted by insects, (2) experiments with several species of bugs appear to confirm the theory advanced that *Moonia albimaculata* is a very probable vector of spike-disease, and (3) lantana aphid (*Macrosiphum*) is also a probable vector of the disease. On the whole, it would appear from Dr. Beeson's post-script at the end of this paper that the Sandal Spike Investigation Board "is not wholly agreed that the available evidence demonstrates conclusively that spike has been experimentally transmitted by insects or that *Moonia albimaculata* is a proved vector." It would appear, on the whole, however, that the problem of insect agency in the dispersal of sandal spike is still a moot question demanding further investigations for confirmation. This is evident from further opinions of a controversial nature expressed on the subject in the columns of *Nature* (1933, p. 592), *The Indian Forester*, (1934 pp. 492 and 505) and later in this journal itself in July last.

It was unfortunate that, in the meantime, the special grant subsidising research on spike-disease expired in September 1933 and the investigations had to be abruptly closed down. In our opinion, though the transmission experiments have carried us considerably forward towards the elucidation of the ways of this mysterious disease there is still room for a good deal of further work in this direction. Speaking of the entomological aspect of the investigations we venture to think that separate observations on the insect fauna of healthy and spiked trees and data collected for each of these sets might have also helped towards the fixing of the transmitting agency to insects if the disease is really insect-borne and in the case of experiments with *Moonia* we venture to think that experiments might have been tried to feed the nymphs of the bug on the infectious material, and allow it to become an adult before it is allowed to feed on a healthy shoot instead of using the adult insect. It is perhaps likely that, as in the case of the insect *Thrips tabaci*—a well-known insect vector, for proper infection of healthy tissue—it is necessary that the young one of the insect should be fed on infectious material and allowed to grow into an adult before it is able to inoculate the toxin. In the event of this investigation being taken up again, it is hoped that this and other lines of research may be tried. It would also be advantageous if an experienced Mycologist or at least one who thoroughly knows the technique of virus studies is also associated in such experiments.

In conclusion, we might add that, whatever might have been the results of the investigations on the main problem, from an entomologist's point of view the results of these faunistic studies present a unique and very valuable contribution both from the academic and economic points of view. For, this series of insect studies, the results of the very first attempt at an exhaustive and systematic study of the insect fauna of a single forest tree in the whole of India, and as such, the insect survey papers have substantially contributed to the subject of entomology as a whole. Entomological workers in general and particularly those in South India are especially indebted to Dr. Beeson who has been mainly responsible for the initiation of these entomological investigations and his assistants Messrs. Dover and Chatterjee for gathering the bulk of the material studied and for arranging to get done this exhaustive survey of the insect fauna of sandal, thus adding substantially to our knowledge not only of the insects associated with sandal but of the insect fauna of the whole of South India. We have also to congratulate them in securing the services of well-known specialists in the different groups who also deserve our thanks.

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