THE SHOT-HOLE BORER PROBLEM

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Although the shot-hole borer beetle is a very small insect its activities as a pest of mid and low-country tea have created a problem of the greatest magnitude for the tea industry. The scientific name of the borer is *Xyleborus fornicatus*, which though suitably expressive may well prove to be a misnomer since, as Dr. Judenko will tell you later, there are strong suspicions that the female borer may be able to produce progeny without copulation!

Shot-hole borer was at a very early date recognised as a serious pest of tea in Ceylon and was the subject of extensive researches by a number of different Government Entomologists. Two of these, Speyer and Jepson, were specially appointed for work on this particular problem. Later, with the establishment of the Tea Research Institute in 1926, responsibility for research on the pest was transferred to the Institute. This was mainly carried out in Uva at our Passara Sub-Station, which was established on Gonakelle Estate in 1935. Shot-hole borer research at Passara was largely carried out by Mr. Austin, who will be addressing you next, and who was transferred to the Tea Research Institute from the Department of Agriculture, bringing with him a wide knowledge of the previous work done on the pest. The names of Dr. Gadd and Mr. Fonseka must also be associated with these Passara experiments.

The main finding from the work carried out at Passara was that the borer attack tended to die out during the third year from pruning, which enabled the Institute to recommend the extension of the pruning cycle to three or more years as a means of reducing the damage caused by the borer.

There the matter apparently rested until I myself made an extensive tour, accompanied by Dr. Haworth and Mr. Passingham, early in 1952, of estates in the Ratnapura district. During this tour I obtained a first-hand impression of the very serious nature of the damage caused by the pest. Furthermore it was immediately apparent that the Institute's recommendation to extend the length of the pruning cycle was of little or no value in districts where, for climatic or other reasons, it was considered impracticable to run a cycle for more than about two years. The need for further research on shot-hole borer under low-country conditions was clearly evident.

Following the report of our tour a meeting with the scientific and agricultural advisers of Messrs. James Finlay & Co. was held at the Tea Research Institute, when the whole problem of shot-hole borer in the Ratnapura district was discussed in considerable detail. As a direct consequence of this meeting arrangements were made to transfer Mr. Austin from Passara to the Ratnapura district for six months to investigate the problem on the spot, with especial reference to the damage caused in young clearings.

Mr. Austin's visit entirely corroborated our opinions concerning the seriousness of the pest and led to the laying down of a number of field experiments in the district during 1953.

However, there was little progress towards any practical solution of the shot-hole borer problem under low-country conditions and in June last year, therefore, I was very pleased to be in a position to recommend to my Board the acceptance of

an offer from Messrs. Fisons Pest Control Ltd. to loan us the services of a research entomologist for work on this problem. This recommendation was accepted by the Board and Dr. Judenko arrived in Ceylon in August 1955 and set up his laboratory at Millawitiya. Since then he has thrown himself into his work with the greatest of keenness and has demonstrated that it would have indeed been difficult for the Institute to have found a special research officer better fitted to deal with the problem allotted him.

However, I must sound a note of warning at this point. The shot-hole borer problem is one which has occupied the attention of a succession of entomologists for the past 50 years and, although Dr. Judenko has the advantage of being able to bring all the recent advances that have been made in entomological science to bear on the problem, he is no miracle worker and our hopes of his being able to produce a practical solution in a short time must not be cast unduly high.

There is little real information regarding the extent of the losses caused by the borer and estimates of experienced planters, which will be brought to your attention later today, range from 100 to 300 pounds per acre per annum in old tea to as high as 500 to 700 pounds per acre in new clearings. In this connection some calculations of the average yields per acre for tea in the different elevation categories may be of interest. The figures were abstracted from the Tea Controller's report for 1953/54 and are before you as Table I.

Table 1. *Figures Abstracted from the Report of the Tea Controller for the tea control year* 1953/54

	High	Medium	Low	All
Elevation	Above 4000'	2000-4000'	Below 2000'	
Acreage.—				
Estate	185,927	198,317	120,225	504,469
Small Holdings*	5,582	40,194	24,005	69,781
Total	191,509	238,511	144,230	575,250
Total yield lbs.	151,090,137	133,953,650	68,771,997	353,815,784
Yield per acre lb.	789	562	477	616
Diff: from general average	+173	—54	—139	—
Total crop lost below general average	—	12,879,594	20,047,970	32,927,564
Diff: from high-grown average:	—	—227	—312	—
Total crop lost below high-grown average	—	54,141,997	44,999,760	99,141,757

**N.B.*—Allocation of acreage between the different elevation categories is only approximate.

One glance at these figures is enough to reveal the truly astounding information that, despite the much higher growth rate of the tea at the lower elevations and much less liability to blister blight attack, the average yields per acre for mid and low-country tea are well below the all Ceylon average, and very much lower than that of the much slower growing high grown tea. There must clearly be some highly

significant factor operating to produce this very large departure from normal expectation and my own opinion is that this factor is none other than that most inconspicuous little beetle, *Xyleborus fornicatus*. If this supposition is correct, and to-date no other equally significant factor affecting yields of mid and low-country tea has been brought to light, then the extent of the losses caused by the borer must indeed be tremendous. Some indication of what these losses might be is given in the table. Thus, if the effects of the borer only operated to depress mid and low-country yields below the all Ceylon average, some 30 million pounds of tea would be being lost per year. However, if its effects were, as they well might be, still more serious and operated to depress mid and low-country yields below the high grown average, then up to 100 million pounds of tea might be being lost per year. Potential losses of this extent are indeed a serious matter to both the tea industry and to Ceylon's economy and clearly indicate that the problem of shot-hole borer merits the closest attention of both the Institute and of the tea industry.

To make sure that the yield trends obtained for 1953/54 were not purely fortuitous I have taken out similar figures from the Tea Controller's report for 1954/55. These are before you in Table 2 and you will see that, although the general level of yields has risen, the same tendency for abnormally low mid and low-country yields is almost exactly repeated. Clearly this is not any chance effect.

Table 2. *Figures abstracted from the Report of the Tea Controller for the tea control year* 1954/55.

	High	Medium	Low	All
Elevation	Above 4000'	2000-4000'	Below 2000'	
Acreage	191,779	233,697	150,008	575,504
Total yield lbs.	155,834,907	143,782,477	77,850,350	377,467,734
Yield per acre lbs.	812	615	519	656
Diff. from general average	+156	—41	—137	—
Total crop lost below general average	—	9,581,577	20,551,096	30,132,673
Diff. from high-grown average	—	—197	—293	—
Total crop lost below high-grown average	—	46,038,309	43,952,344	89,990,653

What now are the principal ways in which borer attack affects yield? To my mind there are several. Firstly, a severe infestation in young clearings prevents the development of good frames. Secondly, the continued increase in the number of galleries below the pruning level eventually leads to a failure of many, otherwise well developed, frame branches to recover from pruning, with a consequent reduction in frame size and loss of yielding capacity. That this is perhaps the most serious effect of borer infestation is supported by the yield pattern shown by many young fields in the Ratnapura district. Here the fields reach their highest yield level of 1,500 to 2,000 pounds per acre within about 10 years from planting and then decline steadily to yield levels of less than 1,000 pounds per acre. Thirdly, as Mr. Webster will tell you later, branch breakage, due to the presence of borer galleries, is probably one of the commonest ways of entry of the woodrot which is such a prominent feature in mid and low-country tea.

There are, of course, many ways in which we can attempt to minimise the loss of yield caused by the borer. Thus, as Mr. Tolhurst will tell you, generous manurial treatment, especially an increase in potash applications, may well keep yields up. However, the interaction of manurial treatments and borer incidence is a long term problem which needs time to evaluate. In this connection it is not inappropriate to point out that more vigorous plants may tend to be more attractive to pests, and that high yields from this cause may prove to be correlated with a higher degree of infestation. This is a situation which clearly requires watching, since a short term palliative measure may turn out to have disastrous long term effects.

Pruning practices are likely to considerably affect borer incidence and here Mr. Walter's contribution is of interest. However, in considering what he puts forward in relation to past research, I trust you will remember that modern systems of pruning at the lower elevations were only introduced after Dr. Tubbs's investigations on starch deficiency in the nineteen thirties. Pruning must, however, be carried out intelligently and obviously pruning heavily infested bushes at a time when recovery must take place into dry weather is likely to lead to increased dieback.

The whole shot-hole borer problem is of a nature which enables intelligent action by the practical planter to play a large part in preventing unnecessary damage. Thus, for example, any cultural operation which will lead to increased branch breakages during the very susceptible second year of the cycle should be avoided if possible. Deep forking of second year fields, and similar operations, belong to this category and are best avoided or else modified to suit prevailing conditions.

Turning now to the various lines of attack against the borer which are open to us, the most important is clearly to have a full understanding of the biology of the pest. Dr. Judenko has been working on this aspect of the problem and has already gone a long way towards clearing up a number of outstanding gaps in our knowledge. He hopes shortly to be in a position to extend his researches to possible methods of control.

Here fortunately we have two lines of attack open to us, since control of the pest can be effected either by direct control of the borer itself or by control of the ambrosia fungus on which it rears its brood. The opportunity that exists here for the development of suitable systemic insecticides or fungicides is clearly a big one.

Direct insecticidal control of the borer has, of course, already been tried out and, of the many insecticides tested, dieldrin has given most promise of effective control. Unfortunately the use of this insecticide can not be recommended by the Institute, since it has very serious effects on the existing biological balance between tea tortrix and its controlling parasite, *Macrocentrus homonae*. Apparently dieldrin is much more effective in killing off Macrocentrus than it is against tortrix, with the result that uncontrolled tortrix attacks tend to develop on treated areas. Furthermore dieldrin belongs to the new range of chlorinated hydrocarbon insecticides, regarding which much concern is now developing in scientific circles on account of their cumulative toxic effects on humans. The widespread use of such an insecticide on a food crop like tea can not therefore be endorsed by the Tea Research Institute, until much more information concerning the long term effects of repeated small intakes on humans becomes available.

Reports have been received recently that certain clones appear to be much less liable to borer attack than others. If these observations are substantiated, then the selection and multiplication by vegetative propagation of planting material resistant to borer attack opens up yet another avenue worth exploring. Any field observations regarding bushes which appear to be resistant to borer attack will accordingly be welcomed by the Institute.

Finally, I would like to again remind you that one of the purposes of the present Symposium is to stimulate an exchange of ideas on the shot-hole borer problem between all interested parties. Many of the contributions to be made today may be expected to contain novel and interesting views on the subject, which may well serve to trigger off new and profitable lines of research. I will therefore close by asking all those attending today to please bring forward any suggestions and observations they may have without reservation during the discussion session which we shall be having this afternoon. Entomology is a science which in the past has been largely developed by amateurs with keen observation, and who can say whether one of the points brought out today will not supply the key to effective shot-hole borer control in the future.