SHOT-HOLE BORER AND WOOD ROT

C. H. GADD

The Shot-hole borer beetle, *Xyleborus fornicatus fornicatior*, bores a gallery or tunnel within the living stems of tea bushes, and places on its walls a fungus, ambrosia, which later forms the food of the beetle and its young. The wood into which the gallery has been bored becomes stained and this discoloration is sometimes interpreted as the beginning of wood rot.[1]

Wood rot is a term used to describe the decay of the woody frame of a tea bush brought about by wood-rotting fungi which gain entry into the bush *via* pruning cuts and other wounds. The decay is often preceded by a discoloration of the wood.

An attempt[2] was made in 1935 to determine whether the discoloration around shot-hole borer galleries was also the beginning of a wood rot. The method then used was to isolate the fungi from the discoloured tissues around the shot-hole borer galleries, and to ascertain whether the fungi so isolated would cause decay of tea wood. The results were negative. Negative results are rarely satisfying because, as in this case, it might be argued that if other methods of isolation and other infested branches were used, one or more wood-rotting fungi might be found in the discoloured wood and so demonstrate that wood-rotting fungi, at least sometimes, gain entry into the frame *via* shot-hole borer galleries.

The results were also unsatisfactory in that they did nothing to explain a planter's observation that borer infested branches cut at one pruning were at the next pruning "found ruined with rot." Even if the above experimental evidence is accepted as conclusive that wood-rotting fungi only rarely gain entry into tissues of the bush *via* shot-hole borer galleries, a further possible explanation of the field-observation remains. It is that invasions of the wood *via* the galleries by fungi, other than those capable of causing direct decay, change the constitution of the wood in such a way as to render it more liable to invasion or to more speedy decay when attacked by wood-rotting fungi admitted through the cut when the branch is pruned. If this is the true explanation of the alleged increase of wood rot following shot-hole borer attack, it would be expected that the extent of rot in a given time after pruning would be greater in infested than in non-infested branches. The problem was, therefore, viewed from this angle, and an investigation was undertaken in the following manner.

Normally when a branch is pruned a new branch arises at, or a little distance away from, the pruning cut. At the end of a further pruning cycle, the new branch is cut back near its base; usually the new cut is at a given distance (often 4 inches) above the level of the previous one. For the purpose of this experiment a number of bushes at the end of a 3-year cycle were pruned; but instead of cutting them normally, the new cuts were made on the previously pruned stem three inches *below* the base of the branch which had grown during the last cycle. Those prunings which exceeded half-an-inch in diameter at

the old pruning cut were removed for further examination. Each "pruning" consisted of the branch which had grown during the cycle, together with at least 3 inches of the parent stem with a 3-year-old pruning cut exceeding half-inch in diameter at the upper end and a new cut at the lower.

The piece of parent stem is important, because it is in this stem that wood rot is to be expected. The fungi causing the rot may have gained entry at the first pruning cut or *via* shot-hole borer galleries occurring in the stem. Any branches which had other means of entry for wood rotting fungi, such as wounds, were discarded

The remaining branches were then split longitudinally to determine whether the branch contained shot-hole borer galleries and to allow the measurement of any wood rot present. From this examination the branches were classified as "with shot-hole borer" and "without shot-hole borer." These classes will be defined more exactly later.

Tea bushes are normally pruned to a level; the branches are not cut back to an "eye" or bud. It is, however, from the uppermost healthy bud that the new branch develops. Consequently, many branches are cut so that the uppermost bud which later forms the new branch, is some appreciable distance below the cut. This piece of stem between the cut and the new growing branch is useless to the bush; it dries out and is commonly known as "Dieback." The length of dieback therefore depends normally upon the distance a pruning cut is made above the bud which develops later into the new stem. Dieback is a natural consequence of pruning and is not due to the invasion of wood-rotting fungi.

It is therefore necessary to distinguish between Dieback and true Wood Rot resulting from the destruction of wood by fungi. The wood of a "dieback" is usually dry, brown and fairly hard but not friable. Dieback never extends below the uppermost new growth except occasionally on the side opposite the new growth. Wood rot is a penetration into "living" wood, usually heart wood, and it is characterised by the rot which makes the wood very friable. Separate measurements, to the nearest quarter inch, were therefore made of the length of dieback and of wood rot in each specimen.

It may be well to restate the problem at this stage. Does attack by shot-hole borer result in an increase of wood rot after the attacked branch is pruned? Any increase in the amount or extent of the wood rot may be due either to a wood-rotting fungus having gained early entrance into the stem *via* the borer's gallery, or to the wood having become more susceptible to rot as the result of the borer's activity. All the specimens had been equally liable to attack by wood-rotting fungi from external sources *via* the first pruning cut for a period of three years. If then, attack by shot-hole borer has no effect on the wood rot which develops later, the same amount of rot would be expected in all branches. But if the borer in any way encouraged wood rot, more rot would be expected in those branches attacked by the borer before pruning.

The borer galleries which are of real importance are, therefore, those to be seen in the dieback and wood rot zones. Galleries in the otherwise healthy stem are of little importance. Consequently the specimens termed "with shot-hole borer" are those which had galleries either on the old cut

or within the dieback or wood rot zones. Specimens without galleries in such places were termed "without shot-hole borer," although one or more galleries may have been present in the otherwise healthy tissues

The shot-hole borer beetle shows a preference for entering tea stems at leaf scars [8] and in doing so frequently causes damage to the bud immediately above and so prevents it from breaking normally after the stem is pruned. This results in a

TABLE I

Length of *Dieback* in pruned stems with and without Shot-hole borer galleries.

Field	Pruning Cycle	With Shot-hole borer				Without Shot-hole borer				Difference	
		No. of Specimens	Mean Diameter of stems	Mean length of Dieback	Standard error	No. of Specimens	Mean Diameter of stems	Mean length of Dieback	Standard error	Mean	Error
	Years		Inches	Inches	Inches		Inches	Inches	Inches	Inches	Inches
A	3	35	·71	0·76	·11	63	·72	0·41	·05	0·35	0·12
B	3	50	·79	0·99	·09	64	·86	0·54	·07	0·45	0·12
C	3	50	·79	0·75	·07	50	·81	0·27	·02	0·48	0·08

TABLE II

Length of *Wood-rot* in pruned stems with and without Shot-hole borer galleries.

Field	Pruning Cycle	With Shot-hole borer			Without Shot-hole borer			Difference	
		No. of Specimens	Mean length of rot	Standard error	No. of Specimens	Mean length of rot	Standard error	Mean	Error
	Years		Inches	Inches		Inches	Inches	Inches	Inches
A	3	35	1·1	·14	63	0·63	·09	0·43	0·17
B	3	50	0·22	·04	64	0·12	·03	0·10	0·05
C.	3	50	0·65	·10	50	0·33	·11	0·32	0·11

A summary of the measurements made by Mr. W. T. Fonseka at the Passara laboratories from specimens from three fields in the Passara district are given in Tables 1 and 2:—

greater length of dieback of borer-infested branches. The figures given in Table 1 illustrate this fact although in neither of the fields was dieback very great The dieback of borer infested branches was approxi-

mately twice as great as that of branches not attacked by borer near the pruning cut.

Table 2 shows a similar result as regards wood rot. The amount of wood rot in the three fields varied considerably but the figures show that there was roughly about twice as much wood rot in the borer-infested branches as in the non-infested. The differences observed are probably real and not due merely to chance (A difference of twice its standard error is accepted as of statistical significance).

This experiment does not give any indication of a reason for the speeding up of the wood rot attack. In view of the previous work, mentioned earlier, it is improbable that wood-rotting fungi normally gain entrance into the stem through shot-hole borer galleries. If that view is accepted it becomes evident that the wood around shot-hole borer galleries either is rendered more susceptible to attack or can be reduced to a friable condition more quickly by wood-rotting fungi after entry.

REFERENCES

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(3). Gadd, C. H.—The Life-History of the Shot-hole borer of Tea.—*Tea Quarterly*, XIV, p. 7, (1941).