

TOLERANCE AND SUSCEPTIBILITY OF TEA CLONES TO SHOT-HOLE BORER INFESTATION

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Introduction

A limited survey of 37 clones was carried out by Judenko (1960) to investigate their tolerance or susceptibility to shot-hole borer infestation. Recent work at the TRI Mid-Country Station has yielded much information on the differential susceptibility or tolerance of tea clones to shot-hole borer infestation.

Materials and methods

The degree of borer infestation of 81 clones grown at the TRI Mid-Country Station in Kandy is being assessed. This paper however will be confined only to 31 clones of the clonal testing experiment MVP1 laid out in 1961. In this experiment 31 clones and one seedling selection are arranged in four randomized blocks of which two are under *Gliricidia* shade planted 14 ft x 14 ft and the other two are unshaded. Each block has 32 plots to which are allotted at random the 31 clones and the one seedling selection. Each plot has 36 plants of each clone, planted in six rows at a spacing of 2 ft in the row, and 4 ft between rows.

Borer damage in the clones was measured by assessing the number of branch breakages in all the plants. Three such observations were made in February 1966 (28 months from prune) ; June 1966 (32 months from prune) and October 1966 (36 months from prune). Further, an estimate of the total number of galleries in the prunings, (the mean per 25 branches per plot), was taken at the end of October 1966 ; and this observation also enabled an evaluation of the sampling method by branch breakage done earlier, so that reliable estimates of borer infestation were obtained. In addition, the weights of the prunings were used to make corrections to account for the variations of the number of branches per bush of the different clones.

One of the limitations of the experiment was that all plots were sprayed with dieldrin soon after they were pruned. This does not, however, invalidate the results obtained because the sampling was done 28 to 36 months after pruning, when the effect of dieldrin had worn off, and also because all plots have been treated alike.

Results

The ability of galleries to heal in different clones

The rate of healing of galleries in different clones was examined and a high correlation ($r = + 0.99$) between the number of healed galleries per branch and the total number of galleries per branch (including open galleries) was obtained. A simple regression on the same data was highly significant ($b = 0.8131 ; P < 0.001$). This indicates that the rate of healing of galleries is nearly the same for all clones and it would appear that no clone has any special ability to bring about healing over other clones (see Figure 1).

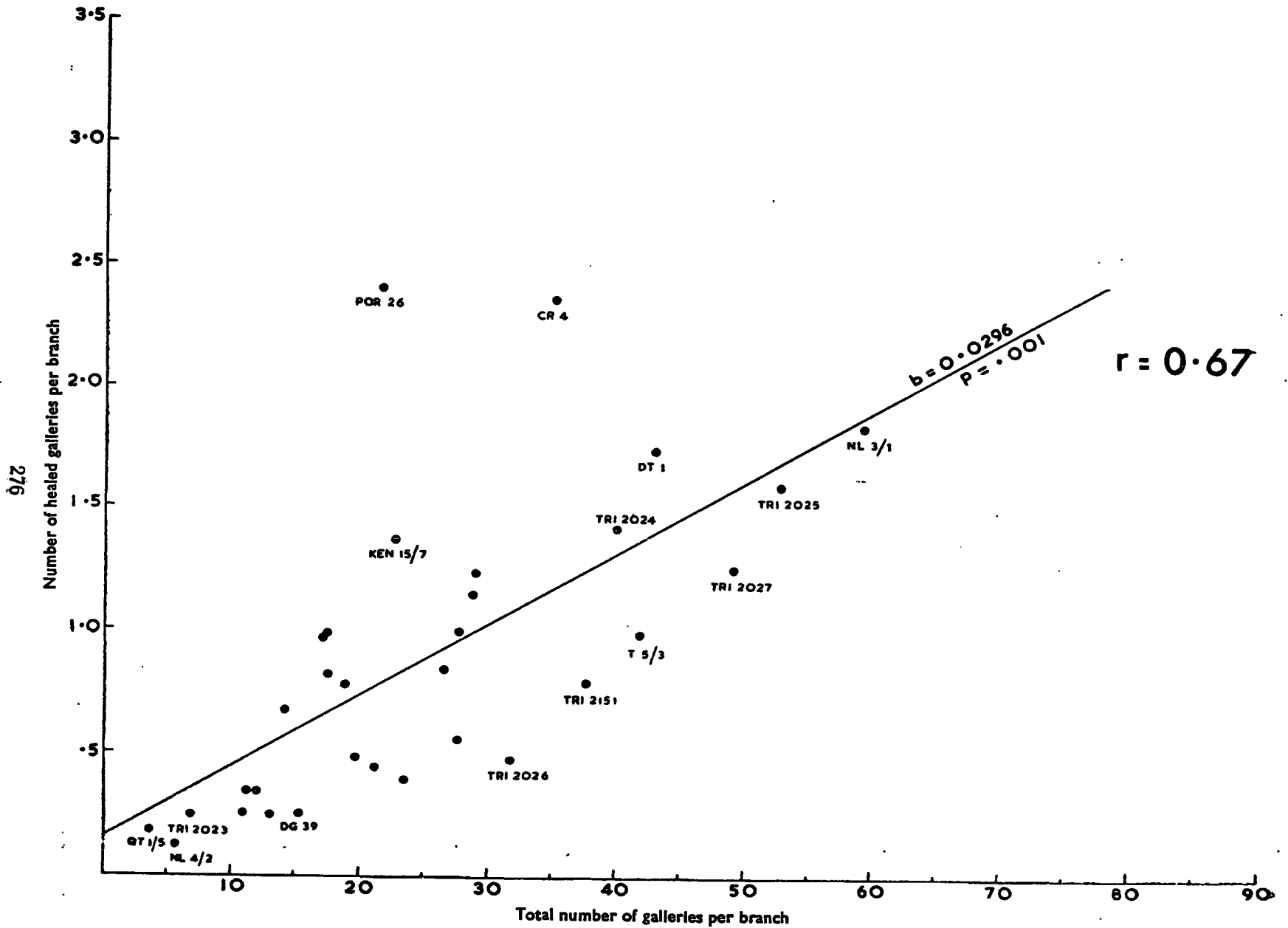


FIGURE 1 — Rate of healing of shot-hole borer galleries in different clones

Tolerance or susceptibility of clones

Figure 2 shows the relation between yield and borer infestation. A simple regression of yield (lb made tea per acre per year) on average galleries per bush, was not significant and there was no significant correlation between these two factors. Not all clones with high yields were heavily infested. The significant difference in the extents to which clones are attacked, as measured by the two methods, are listed in Table 1.

TABLE 1—*Shot-hole borer attack on 32 clones as measured by (1) branch breakage and (2) the number of galleries in pruned branches*

Branch breakage/bush (Mean of three observations)		Total galleries/25 branches/plot (in prunings)	
NL 4/2	0.12	QT 1/5	13.75
QT 1/5	0.18	2023	19.50
T 5/35	0.24	NL 4/2	20.00
2023	0.24	DN	34.50
DG 39	0.25	BG 18	36.00
BG 18	0.25	MT/BG	39.00
DM	0.34	T 5/35	44.50
MT/BG	0.34	UH 9/3	55.25
TK 48	0.39	PAS 22	56.50
EN 31	0.44	DG 39	56.50
2026	0.47	K 150	58.25
PAS 22	0.48	CV4B1	68.50
K 136	0.55	EN 31	68.75
UH 9/3	0.67	SEED	78.75
SEED	0.78	777	88.25
2151	0.79	KEN 15/7	88.75
777	0.82	2026	88.75
CY 9	0.84	GMT 9	91.75
K 150	0.97	PO 26	92.00
T 5/3	0.99	CY 9	95.00
CV4B1	0.99	K 136	95.00
GMT 9	1.00	KEN 16/3	96.75
KEN 16/3	1.15	TK 48	119.00
CV5B1	1.24	2024	121.75
2027	1.26	CV5B1	122.50
KEN 15/7	1.38	CR 4	127.50
2024	1.43	DT 1	134.75
2025	1.60	2151	136.50
DT 1	1.75	2027	138.25
NL 3/1	1.84	T 5/3	147.50
CR 4	2.36	NL 3/1	174.00
PO 26	2.40	2025	200.50
Significant difference at	P=0.05	.. 0.82 52.61
	P=0.01	... 1.09 69.72
	P=0.001	.. 1.42 90.25

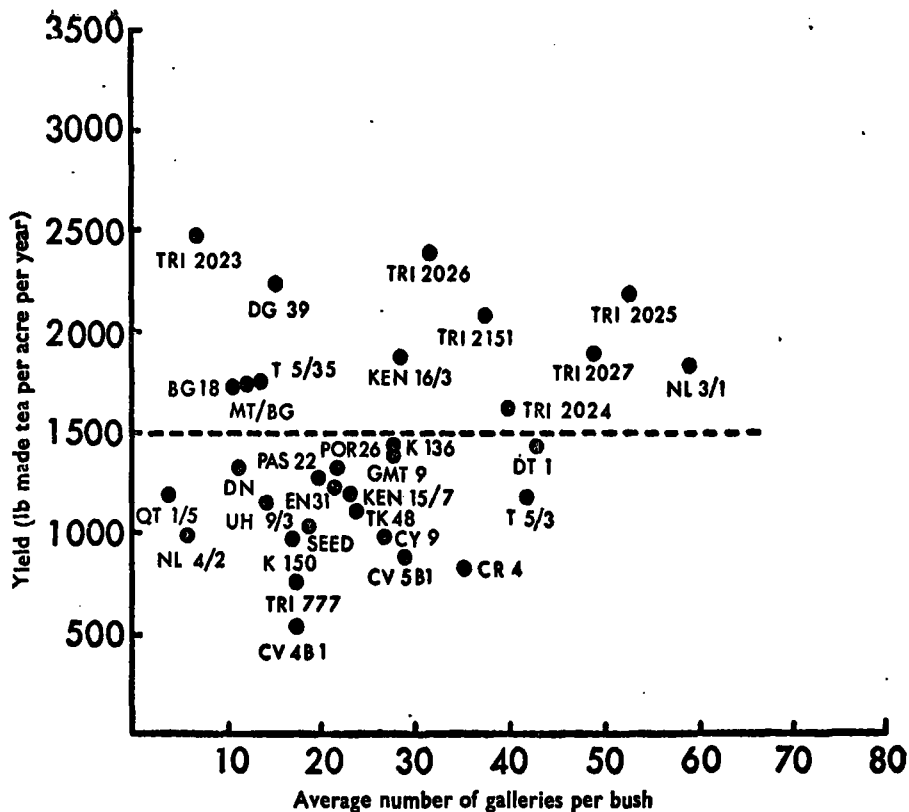


FIGURE 2 — *The relationship between shot-hole borer infestation and yield of tea*

TABLE 2—*Comparison of shot-hole borer attack on 32 clones planted in 1961 under shade and unshaded*

Branch breakage (Mean per bush)	Shade	No Shade	Significant difference	% increase under shade
1st observation (February 1966) 28 months from prune ..	1.63	0.99	0.60 P=0.05	65
2nd observation (June 1966) 32 months from prune ..	1.06	0.74	0.32 P=0.001	43
3rd observation (October 1966) 36 months from prune ..	0.54	0.40	0.14 P=0.01	35
Total galleries in prunings (Mean per 25 branches per plot) October 1966 ..	96.94	78.39	17.44 P=0.01	24
% healed galleries in prunings ..	87.18	80.97	5.93 P=0.001	8

Infestations under shaded and unshaded conditions

There was consistently less borer damage on unshaded tea and significantly heavier infestation on shaded tea. The three estimation of branch breakage as well as the estimates of galleries in the pruned branches showed an average of 42% heavier borer damage on the shaded tea (see Table 2). The galleries in tea stems healed significantly better, however, in the shaded clones.

TABLE 3 — *A tentative list of clonal characteristics*

Yield (in order of merit)	Quality	Drought Resistance	Shot-hole borer Tolerance
TRI 2023	++	+	+++
TRI 2026	—	—	—
TRI 2025 (>2000 lb)	+	++	—
DG 39	++	++	++
TRI 2151	++	+	—
KEN 16/3	+	+	+
TRI 2027	+	++	—
T 5/35	+	+	++
MT/BG	+	++	++
BG 18	+	+	++
NL 3/1	++	+	—
TRI 2024 (>1400 lb)	++	—	—
DT 1	+++	++	—
K 136	++	+	+
GMT 9	?	+	+
DN	+	+++	++
QT 1/5	+	+	+++
PAS 22	—	—	++
PO 26	+	—	+
T 5/3	—	+	—
EN 31 (>100 lb)	++	++	+
TK 48	++	++	+
KEN 15/7	++	++	+
UH 9/3	+	—	++
SEED	—	+	++
NL 4/2	+++	—	+++
CY 9	—	++	+
K 150	++	—	++
TRI 777	+++	++	++
CV5B1	—	+++	+
CR 4	—	++	—
CV4B1	++	+++	++

Grade	Score	Galleries in Prunings
+++ Excellent A1	>90%	<20%
++ Good A2	>50%	<40%
+ Moderate B	>30%	<60%
— Bad C	>30%	<60%

Evidence from visual observations

The Helbodde clone H6A1 showed extreme damage and many branch breakages because of shot-hole borer attack, so much so, that this clone has not yet developed into a bush, in an experiment (MVP2*) planted in 1962 while the 15 other clones planted at the same time have grown up to reasonable-sized bushes which are in plucking. Subsequent inquiries revealed that Hellbodde Estate itself has abandoned the propagation of this clone as they had found it extremely susceptible to shot-hole borer attack.

The Tangakelle clones WY and CY9 showed a chlorotic condition, and on examination all the chlorotic branches were found to be riddled with borer galleries. This chlorotic condition was an indication of the extreme susceptibility of these clones to shot-hole borer attack. The condition was more evident during drought periods. It would seem that shot-hole borer damage aggravates the ill-effects of drought on VP tea.

Clonal characteristics

As yield is the primary characteristic required, we have attempted, from the available information, to effect an arbitrary comparison of the 31 clones and the one selected seedling progeny as regards yield (arranged in order of merit in Table 3) and the other characteristics of the quality of the made tea, the ability to resist drought, and shot-hole borer tolerance. This list is tentative *and the positions of the clones in this list may probably change as and when more information is available.*

Discussion

The above information on clonal characteristics of 31 clones outlined in this paper, with particular reference to shot-hole borer tolerance, is applicable only to mid-country conditions. Now that we have established the accuracy of a convenient method of sampling VP tea in experimental plots for estimating shot-hole borer damage, similar investigations in the varying climatic conditions of Uva and the Low Country would seem to be desirable. At the Mid-Country Station itself, these investigations continue and a final evaluation of clonal characteristics will have to wait further research.

There is evidence of heavier shot-hole borer attack on shaded tea. This is to be expected for two reasons. Firstly, the fluctuations in the microclimate under the sheltered conditions are much less than under open situations and this is suitable for the unhindered growth of insect populations. Secondly, because it is known that the main method of the dispersal of Shot-hole Borer is by aerial migration (Calnaido 1965), the shade trees may have had a screening effect on the airborne populations.

Clone TRI 2023 appears to be the best clone for shot-hole borer tolerance, with less than 20% attack, and is also high-yielding although it is not very resistant to drought conditions. It may be premature to name this as the best clone for the Mid Country at this stage, but there is no doubt that it will rank among the best.

The TRI clones 2025, 2151, 2026 and 2027 were high yielders in spite of the heavy shot-hole borer attacks, and these clones may have yielded much more if the borer damage could have been prevented. However, because depression of yields is a primary effect of shot-hole borer attack while the secondary effects, such as wood-rot and the eventual delapidation of the tea bush are no less important, clones susceptible to borer attack cannot be considered favourably for mid-country propagation until such time as we arrive at a safe means of controlling this pest.

* For experiment number see TRI Annual Report, Part 2, 1965.

Of the estate clones, the Balangoda clones appear to do well from the point of view of Shot-hole Borer. Clone DG 39 stands out as a good all-rounder for mid-country propagation. Another estate clone of considerable interest is DT 1, because this quality clone has proved tolerant to eelworm although it was heavily attacked by the borer. If DT 1 could be protected from shot-hole borer damage, its yield may be stepped up and it may prove to be a very desirable clone.

Once again we would like to stress the fact that these results are subject to test by further experimentation. They should, however, be helpful as an immediate guide for the planter who has to decide now on what clones to choose for mid-country propagation and they may also be a useful source of information for the prospective plant breeder.

Summary

- 1 - The shot-hole borer tolerance and susceptibility of 31 clones and one seedling progeny has been investigated by assessing branch breakages and examining prunings. These results have been examined in the light of other desirable characteristics of clones such as yield, quality and drought resistance for mid-country propagation.
- 2 - Clone TRI 2023 appears to be a good clone for the mid-country propagation from the point of view of shot-hole borer tolerance and the other characteristics considered here. Clone DG 39 appears to be a good all-rounder.
- 3 - Shot-hole borer infestations were heavier under shade.
- 4 - Shot-hole borer infestations in experimental plots may be assessed by the branch breakage method.
- 5 - The rate of healing of galleries of the 31 clones and one seedling progeny tested here are about the same.

Acknowledgements

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