KTC 44 A. Cacao Establishment/Dieback Trial 1.

John O' Donohue

Aims:

To determine (1) the degree of success to be had in planting cacao adjacent to mature cacao which was infected by vascular-streak dieback and not treated for the disease, and (2) the order of the distance from such infected cacao at which the infection rate in the new plantings fell to the base level.

Materials and Methods:

In January 1969 open-pollinated seed from clones exhibiting resistance to vascular-streak dieback was bulked, thoughly mixed and planted into Block 708. The sites planted were formerly occupied by Clone Testing Series IV, Clone Testing Series V (both part of KTC 5), the Cuttings spacing/Pruning Trial (KTC 6) and Amazonian Block 6/part of KTC 10). For the purposes of KTC 44 these sites were designated Block I (853 positions) II (465) III (812) & IV (202), respectively. The seeds were planted two to a position on a 16.5m x 1.8m (actually 54 ft 6 gy.) grid pattern, pattern was chosen simply to reduce the requirement for seed for planting and, eventually, material to be recorded.

No replanting was carried out at any stage. The stand was thinned to one seedling per position in March 1970. Using seed from clones susceptible to dieback would have given quicker and more definite infection gradient results.

The Cacao in Blocks I,II and III was grown under established Leucaena leucocephala shade, while that seven in Block IV was established under shade provided by oil palm fronds laid on a framework about 1.2m above the ground. The fronds were re-arranged twice but were not added to. They were finally removed in October 1969 by which time they were providing very little shade and the most advanced seedlings were growing through them. The seedlings in this section grew for the rest of the trial without any overhead shade.

Fertilizer was applied to all positions in the trial at 3-monthly intervals from age 8 months. Initial applications were 50g of ammonium sulphate per position, increased to 75g at 20 months of age.

Four weekly dieback inspections were commenced in October 1969 and infections were e recorded and treated, by pruning of possible or by tree removal if not.

The layout of the trial is shown in Figure 1 and the position of the mature trees which acted as the source of infection for the trial is indicated. The cacao referred to as "Plantation" is sited on a private property immediately adjacent to the KTC 44 area, as shown on the diagram. This cacao was planted in 1959 and virtually no dieback pruning had been carried out on it. The level of infection at the beginning of the trial was moderate. The cacao in Clone Testing Series I & II was planted in 1956-57. Pruning for dieback had been carried out regularly up to just prior to the commencement of KTC 30, when it was discontinued. All other cacao in the immediate vicinity of the trial area was removed prior to January 1969 to avoid the complication of infection gradients from other directions. Apart from the trees which provided the inoculum source, which in the case of the plantation stand extended for about 1.5 kilometres from KTC 44, the nearest plantings in any other direction were more than 600 metres distant.

The trial cacao extended about 400 metres in the north-west/south-east direction, which is the direction of the prevailing winds.

Results:

The total numbers of infections recorded to the end of June 1970 and to the end of Hybe 1971 are given in Table 1. Each figure repsents the total for a group of 17 trees comprising a corner tree and the 8 trees in the line running north-east from it plus the 8 trees in the line running south-east from the corner tree This is illustrated in Figure 1. Growth records for groups of either 12 or 16 corner trees (at the intersections of lines and rows) are given in Table 2 as means per tree. Where a tree had rainified the height recorded was the height to the foiquette plus the length of the longest branch. The percentages of measured trees in each of the four blocks which had ranified by the day of recordingin January 1970 and July 1970 are presented in Table 3.

Discussion:

Although tree numbers were low, particularly in the case of the unshaded block (Block IV) at the July 1970 recording when only 12 trees were measured, the figures in Table 3 indicate that the unshaded block was the most advamced in the trial.

This would have made it more prone to infection than the other blocks in the early stages, given that a greater proportion of ranified seedlings would mean a greater number of volue able leaves for infection. Keaney Flentje and Lamb (1972) have shown that the point of entry of the fungus of vascular streak dieback Oncobasidium theobromae, is almost certainly the unbardened leaves. On the other hand, tree survival was lowest in this block (see Table 4) owing mainly to wind damage, and this would tend to offset the effects of the greater flush leaf area of each tree. The figures in Table 4 represent losses from all causes. Dieback was responsible for the greater rate of tree loss in Block I than in Blcoks II and III, whereas exposure to wind and sun brought about most of the deaths in the unshaded area. Losses attributable to dieback resulted from removal of infected seedlings or death following stumping. No regular records of misses were taken so the number of infections per reading per block cannot be related to number of surviving trees at each reading. However, it is of value to compare number of infections per 100 surviving trees in the four blocks. For this pursose, number of infections is taken as the total recorded in the 12 months from 1st July 1970, and tree numbers are taken as the numbers are taken as the numbers surviving as at April 1972. These figures are presented in Table 5.

The figures in Table 5 indicate that Block I, as expected, had the highest infection rate as it was closest to the major infection sources. The infection rate in the unshaded block Block IV, was higher than in the two shaded areas adjacent to it even though it is further from sources of infection. The aim of the no-shade treatment was to determine whether the unshaded conditions led to less infection through promoting a drier micro-climate around the trees. However, the opposite has occurred and it is suggested that the reason is that the absence of shade has meant no filtering of spores as they descend through the air. Keane et al (1972) have shown that the spores of the fungus Oncobasidium are shed mostly at night, when the microclimatic conditions suitable for successful infection would not depend on the overhead shade. Low infection rates have been recorded under very heavy shade (KTC 30) and it is suggested that this is because a percentage of the spores in the air are arrested by the leaves of the shade trees and lose viability before passing through to the cacao, if they do. Keane et al (1971) have showen the relatively short-lived nature of the spores.

The majority of seedlings would leave ranified by the June 1970 recording (age 17 months) so that tree size differences would have tended to reduce infection in the unshaded area by comparison with the shaded areas between July 1970 and June 1971. The greater rate of infection per 100 surviving trees is all the more significant because of this.

Conclusions:

(1) The establishment of seedlings in the in the immediate vicinity of sources of dieback infection without replanting was unsuccessful. The state of the planting nearest this source as at April 1972 is indicated by the data in Table 6, which refers to the corner of Block I nearest Series I and an equal area of Block III.

The stand within about 60 metres of the nearest source of infection, Series I, could not be classed as satisfactory.

(2) The gradient of infection appears to have levelled out about 60-70 metres into the block. The only gradient of any importance was one running almost diagonally across the block from the corner nearest the Plantation stand and Series I. Why Series II had little impact as an infection source is mot immediately obvious. The reason may be in the different composition of the two Series. In the Cuttings Resistance Trial KTC 30 there were strong indications that some clones once infected are much more virulent sources of infection then others. These clones are usually very susceptible themselves and support vigorous growth of the fungus.

The composition of the sections of Series I and II nearest KTC 44 is indicated in Figure 2, together with a notation regarding the resistance of each clone as assessed by field inspection in July 1966 and July 1968. Thus the general level of resistance rises from Series I towards Series II, and this may have lead to fewer infections in the Series II trees and a reduced inoculum source.

(3) In terms of the original aims of the trial the growth differences recorded between Blocks would have made no significant difference to the conclusions.

Table 1

(a) Total Infections per group of 17 trees to the end of June 1970.

Block I

1	1	2	1	2	3	1	1
6	4	0	3	1	0	4	1
6	3	4	2	2	0	0	1
11	6	5	3	3	3	3	0
15	5	2	4	4	2	2	3
14	10	8	6	1	2	1	5

Block II

6	0	2	1						
4	3	0	2	3	1	3	1	1	1
4	2	1	0	0	0	1	3	3	2

Block III

0	2	4	3	0	1
0	1	2	1	1	2
2	0	2	0	1	0
1	3	0	1	0	2
1	0	1	0	0	0
0	0	0	0	1	1
1	0	1	1	1	0

Block IV

1	3	1
1	2	1
0	0	0
1	0	1

(b) Total infections per group of 17 trees to the end of June 1971.

I

5	12	9	5	5	5	2	6
15	14	7	9	9	7	5	4
17	12	16	10	9	9	5	2
27	24	17	20	12	5	9	4
31	34	13	17	16	8	15	9
32	24	25	27	13	19	18	12

II

10	5	7	5						
12	8	6	6	12	11	9	6	6	8
16	5	8	6	3	7	7	9	5	4

Z

2	11	11	4	8	4
3	8	9	6	4	3
7	8	5	7	6	2
5	5	4	1	6	5
4	2	4	1	0	0
5	2	3	3	3	1
4	1	7	3	4	1

IV

2	5	3
4	3	4
6	4	3
3	5	5

Table 2.

Growth records of corner trees in KTC 44.

(a) Height (cms) in January 1970.

35	43	128	105	120	121	120	151																
-	88	92	131	129	183	162	104																
194	118	76	133	129	156	132	130																
201	133	134	121	67	132	93	108	97	149	91	118							129	125	127	102	98	90
133	137	129	116	114	77	120	57	118	94	92	85	127	50	110	161	101	142	148	117	149	142	149	34
129	98	100	158	108	193	133	162	116	105	106	161	149	113	77	117	140	146	70	81	128	127	137	115
124	173	128	109	97	192	155	184	91	123	113	97	102	76	83	158	140	76	57	103	114	116	77	121
																		86	67	57	35	116	96
																		106	112	86	40	148	139
																		90	79	134	123	104	147
																		110	163	105	116	44	-
																		92	94	121			
																		102	93	188			
																		162	132	119			
																		87	143	141			

Table 2.

Growth records of corner trees in KTC 44.

(a) Height (cms) in January 1970.

35	43	128	105	120	121	120	151																
-	88	92	131	129	183	162	104																
194	118	76	133	129	156	132	130																
201	133	134	121	67	132	93	108	97	149	91	118							129	125	127	102	98	90
133	137	129	116	114	77	120	57	118	94	92	85	127	50	110	161	101	142	148	117	149	142	149	34
129	98	100	158	108	193	133	162	116	105	106	161	149	113	77	117	140	146	70	81	128	127	137	115
124	173	128	109	97	192	155	184	91	123	113	97	102	76	83	158	140	76	57	103	114	116	77	121
																		86	67	57	35	116	96
																		106	112	86	40	148	139
																		90	79	134	123	104	147
																		110	163	105	116	44	-
																		92	94	121			
																		102	93	188			
																		162	132	119			
																		87	143	141			

(b) Heights (cms) in July 1970.

86	143	245	191	243	228	247	257
161	199	216	306	290	261	256	211
258	261	166	239	273	223	266	245
332	351	270	272	152	281	206	320
269	242	275	236	323	227	254	149
225	221	237	234	284	274	218	229
187	276	282	252	237	322	251	291

203	241	200	232						
241	185	264	256	306	162	212	248	216	267
240	259	214	290	292	186	245	205	243	234
188	244	254	211	224	181	180	189	249	211

276	270	306	238	224	286
301	216	237	236	263	91
220	178	255	279	258	244
145	260	259	269	198	179
201	237	102	110	207	217
185	239	214	225	246	284
179	201	242	279	320	238
221	261	189	207	127	-
214	203	234			
113	153	259			
261	215	286			
207	170	243			

(c) Girths (dmm) in February 1971.

[illegible]

[illegible]

(c) Girths (cms) in February 1971.

7	8	12	12	12	12	16	10																
11	10	12	15	12	12	11	11																
13	16	10	7	12	11	12	13																
16	12	15	12	9	16	12	18	11	16	16	10							12	18	12	14	9	11
17	15	15	13	15	15	17	8	11	11	14	12	16	10	14	19	17	14	14	12	14	19	13	17
11	15	12	14	13	12	14	8	15	12	16	20	15	14	17	14	16	13	12	13	17	5	13	8
5	14	14	16	14	14	9	19	13	11	13	13	12	13	14	21	11	12	9	14	13	8	9	15
																		9	14	8	16	11	15
																		12	10	15	13	14	6
																		12	11	15	14	11	14
																		14	15	13	11	9	-
																		9	12	13			
																		13	15	13			
																		12	13	15			
																		12	12	12			

(d) Girth (cms) in August 1971.

12	15	19	17	20	18	14	15																
20	-	17	22	19	25	19	17																
19	22	-	12	21	17	21	19																
-	18	22	17	14	22	18	26	17	23	20	14							13	21	20	16	15	13
24	21	23	19	18	23	18	15	20	15	23	19	19	21	20	26	17	23	22	17	20	21	19	22
-	15	15	19	22	-	16	-	17	20	21	27	25	21	-	22	24	21	18	-	24	22	16	22
-	-	21	22	18	19	21	26	-	18	21	20	23	18	21	26	27	19	22	22	23	19	16	9
																		11	20	13	-	21	24
																		17	20	20	-	22	18
																		20	17	21	27	18	22
																		-	23	22	19	13	-
																		12	19	22			
																		27	20	20			
																		22	19	18			
																		27	20	21			

Table 3.

Percentage of measured trees which had ranified by January 1970 and July 1970.

	Jan 1970	July 1970
Block I	23	91
Block II	39	91
Block III	21	89
Block IV	67	100

Table 4.

Vacant positions as at March 1970 and April 1972.

	March 1970		April 1972	
	Number	% of total positions	Number	% of total positions
Block I	16	2	187	22
Block II	4	1	51	11
Block III	13	2	101	12
Block IV	2	1	110	54

Table 5.

Infections per 100 trees surviving at April 1972.

	Total infections July 70-June 71 (incl)	as at April 1972	Infections/100 trees
Block I	463	666	70
Block II	137	414	33
Block III	154	711	22
Block IV	36	92	39

Table 6.

Misses, stumps and trees in part of Block I and part of Block III as at April 1972.

	Block I	Block III
Total positions considered.	345	345
Missing	115	36
Stumped	44	33
Normal	86	276

Figure 2.

KTC 44 - Block I

K24-103	K12-101	K23-105	K12-101	KA5-104	KA2-105	K23-106	K25-102	K6-101
GOOD	POOR	VERY POOR	POOR	FAIR	GOOD	FAIR	POOR	FAIR GOOD
K5 POOR			K52 POOR			K1-103 FAIR		