

EFFECTS OF A LIGHTNING STRIKE ON COCONUTS, CACAO AND LEUCAENA LEUCOCEPHALA IN A MIXED PLANTING IN THE GAZELLE PENINSULA

R. J. VAN VELSEN* AND I. L. EDWARD†

ABSTRACT

The effects of a lightning strike on coconuts, cacao and Leucaena leucocephala in a mixed planting in the Gazelle Peninsula, New Britain, are described.

The effects of a lightning strike on coconuts, cacao and leucaena were observed at intervals of 1 day, 7 days, 21 days, 7 weeks, 19 weeks and 32 weeks after the strike. Three coconut palms showed symptoms within 24 hours and others developed symptoms for the first time between 3 and 7 weeks after the strike. Survivors were showing recovery by the nineteenth week. Affected cacao trees were recovering by the time of the 7-week reading. Foliage damage on the cacao trees was similar to that produced by fire. Leucaena trees appeared to be more tolerant of the effects of the strike than cacao or coconuts.

INTRODUCTION

SEVERAL plantations in the Gazelle Peninsula, New Britain (New Guinea), had reported restricted areas of cacao (*Theobroma cacao* L.) and the shade tree *Leucaena leucocephala* suddenly dying from unknown causes. One such area has been investigated and recorded (Shaw and Van Velsen 1968).

On the afternoon of 28 April 1966, lightning was observed by Edward to strike several coconut palms on a plantation near Kokopo on the Gazelle Peninsula. The palms struck by lightning were located the same afternoon. Cacao trees with some *L. leucocephala* shade trees were planted between the coconuts. In order to determine the spread of mortality and the extent of recovery, observations and recordings were made in the affected area at the following intervals after the strike: 24 hours, 7 days, 21 days, 7 weeks, 19 weeks and 32 weeks.

RECORDS

At each visit records were made of the extent of damage to individual trees and any signs of

recovery. In the Figure, coconut, cacao and *L. leucocephala* trees in the observation area are shown.

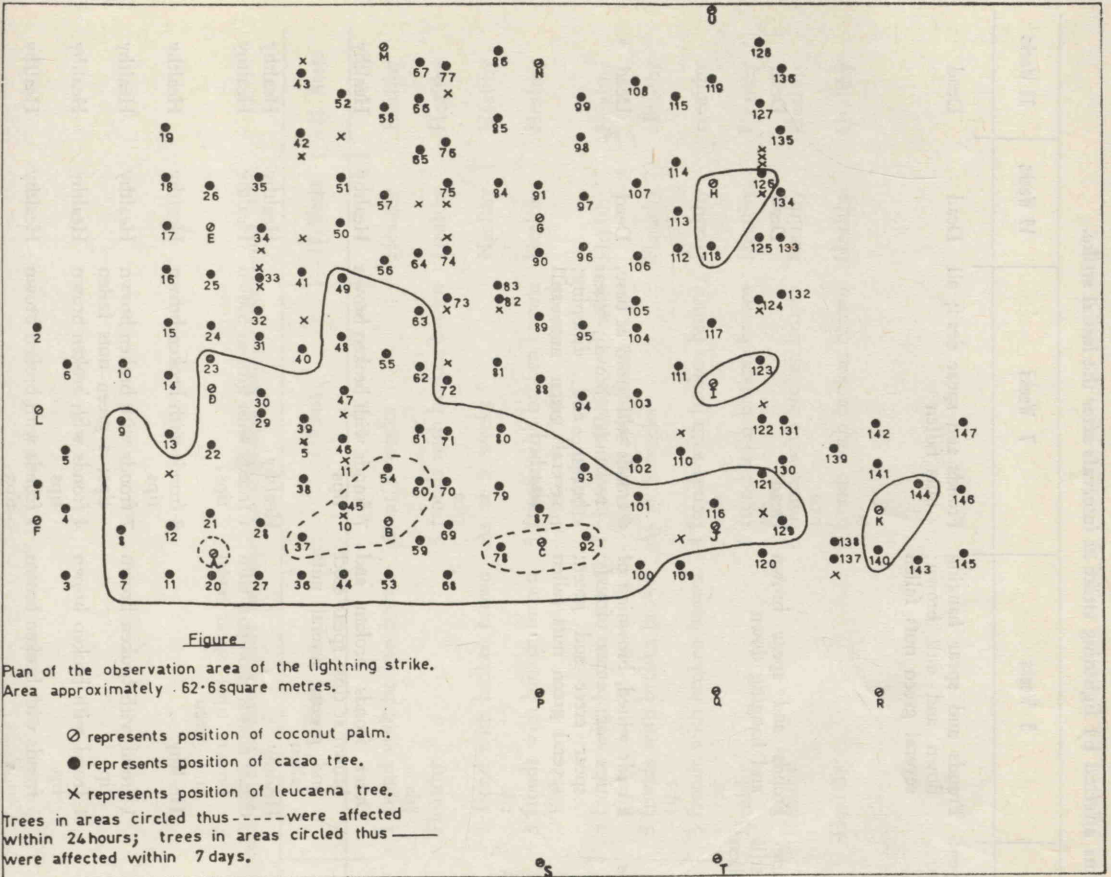
Coconuts

The coconuts in the area affected by the lightning strike were all pre-1939 planting and were approximately 20 m or about 60 ft tall. On the first visit (at 24 hours after the strike) palms A, B and C (see Figure) were the only ones showing symptoms. Edward had observed these palms to be affected one hour after the strike. On the second visit, one week after the strike, palms D and J were showing some frond damage and on the third visit, 21 days after the strike, palms F, H, I, K, M, N, P, Q and R were also showing frond damage. For ease in comparing progress of symptoms, the damage observed at each visit is tabulated in the Table.

From these observations it is evident that in a number of palms the effect of the strike was not noticeable for some time after its occurrence. This delayed effect was recorded by Charles (1960) and Shaw (1968). At the end of 32 weeks, only three of the affected palms had died and other palms which had shown frond damage appeared to have recovered. The centre of the strike appears to have been at palms A, B and

* Formerly Senior Plant Pathologist, Keravat, New Britain. Present address: Department of Agriculture, Adelaide, South Australia.

† Manager, Plantation, Kokopo, New Britain.



SCALE

0.5 cm = 3.8 m
($\frac{1}{2}$ in = 32.4 ft)

C. On other affected palms, the initial damage was a breakage of the midrib 46 to 90 cm (18 to 36 in) from the frond tip and subsequent browning of the leaflets beyond the break.

Symptoms first appeared on the older fronds (that is, the fronds at the base of the head) progressing to the younger fronds. Each frond appeared to die from the tip with death progressing to the base. Immature green nuts fell prior to the death of the spear, which was the last part of the cabbage to die.

Theobroma cacao

The cacao trees, approximately 8 to 12 years old, were interplanted between the coconuts, together with scattered *L. leucocephala* shade

trees. They were approximately 3 to 4.5 m (10 ft to 15 ft) tall and were vigorous bearing trees. On the first visit, the trees numbered 37, 45, 54, 60, 78 and 92 showed a dark green to black discolouration of the mature leaves on the branches closest to the coconut palms B and C. Young pink leaves had a dark brown discolouration of the mid and secondary veins. This damage resembled heat damage from a ground fire. No fire was observed in the area during the storm. No other cacao tree was found to be affected at this time. However one week later many trees were observed to be affected with mild to severe darkening of the foliage. The trees were divided into seven groups according to severity of symptoms as follows:

Table.—The symptoms on coconut palms affected by lightning strike at intervals after the initial strike.

Palm	24 Hours	1 Week	3 Weeks	7 Weeks	19 Weeks	32 Weeks
A	Several fronds with brown tips; crown appeared wilted; piece of stem 61 cm by 12.7 cm by 3.8 cm blown out approx. 12.2 m (40 ft) above ground level	All fronds wilted; spear still green	Fronds and spear hanging down and dull brown; several green nuts fallen	Fronds and spear dead; all nuts fallen	Dead	Dead
B	Fronds appeared healthy; 2 patches of fibre extruded from stem at 4.58 m and 5.49 m above ground level; each area 61 cm by 5 cm	Fronds brown and hanging down; spear still green; all nuts fallen	Fronds and spear brown and hanging down	Dead	Dead	Dead
C	3 young fronds on ground with brown scorch patches; small areas, approx. 10 cm by 5 cm, of exposed fibre from ground level to 3.05 m on the trunk; groove 7.6 cm wide and 10 cm deep carved through fibrous roots at the base of the palm	No further symptoms	Fronds wilted, browning of tips of outer fronds; spear erect and green; several green nuts fallen	6 fronds still green at base, remainder brown; spear brown and drooping; several green nuts still attached	Dead	Dead
D	Healthy	2 fronds tattered	Outer fronds broken and brown at tips; spear erect and green; several nuts fallen	7 fronds with broken brown tips	Healthy	Healthy
E	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy
F	Healthy	Healthy	Outer fronds drooping with brown tips; spear erect and green	4 fronds with broken brown tips	Healthy	Healthy
G	Healthy	Healthy	Healthy	8 fronds with broken brown tips	Healthy	Healthy
H	Healthy	Healthy	1 frond with broken brown tip	7 fronds with broken brown tips; 4 green nuts fallen	Healthy	Healthy
I	Healthy	Healthy	1 frond with broken brown tip	4 fronds with broken brown tips	Healthy	Healthy
J	Healthy	2 fronds tattered	3 fronds with broken brown tips	7 fronds with broken brown tips	Healthy	Healthy

Table.—The symptoms on coconut palms affected by lightning strike at intervals after the initial strike—*continued*.

Palm	24 Hours	1 Week	3 Weeks	7 Weeks	19 Weeks	32 Weeks
K	Healthy	Healthy	1 frond with broken brown tip	At at 3 weeks	Healthy	Healthy
L	Healthy	Healthy	Healthy	3 fronds with broken brown tips	Healthy	Healthy
M	Healthy	Healthy	1 frond with broken brown tip	As at 3 weeks	Healthy	Healthy
N	Healthy	Healthy	3 fronds with broken brown tips	3 fronds with broken brown tips; 3 with tattered appearance	Healthy	Healthy
P	Healthy	Healthy	4 fronds with broken brown tips	4 brown fronds, 2 with tattered appearance	Healthy	Healthy
Q	Healthy	Healthy	6 fronds with broken brown tips	As at 3 weeks	Healthy	Healthy
R	Healthy	Healthy	3 fronds with broken brown tips	4 fronds with broken brown tips	Healthy	Healthy
S	Healthy	Healthy	Healthy	1 frond with broken brown tip	Healthy	Healthy
T	Healthy	Healthy	Healthy	6 fronds with broken brown tips	Healthy	Healthy
U	Healthy	Healthy	Healthy	3 fronds with broken brown tips	Healthy	Healthy

- (i) Trees showing no foliage symptoms: trees 1 to 6 inclusive, 10, 13 to 19, 24 to 26, 31 to 35, 40 to 43, 50 to 52, 56 to 58, 64 to 67, 72 to 77, 81 to 86, 88 to 91, 94 to 99, 102 to 115, 117, 119, 120, 122, 124, 125, 127, 128, 130 to 139, 141 to 143, 145. These trees showed no symptoms on the first and subsequent visits.
- (ii) One branch with 3 to 6 dark green mottled leaves at the tip; trees 7, 8, 9, 62, 118, 121, 126, 129, 140.
- (iii) Two branches with 3 to 6 dark green mottled leaves at the tips: trees 30, 49, 55, 69, 71, 116, 123, 144.
- (iv) Three branches with 3 to 6 dark green mottled leaves at the tips: trees 29, 48, 68, 70, 101.
- (v) Four branches with 3 to 6 dark green mottled leaves at the tips: tree 100.
- (vi) Trees with some branches and all leaves showing dark green mottling: trees 23, 53, 1 branch affected out of 5 (1/5); 28, 80 (2/5); 27, 59, 61 (3/5); 20, 46, 93 (4/5); 36 (2/6); 47, 79, 92 (3/6); 44 (4/6); 87 (3/4).
- (vii) Trees with complete defoliation: trees 11, 12, 21, 22, 37, 38, 39, 45, 54, 60, 78.

On the third visit, three weeks after the strike, the dark green mottled leaves present on the second visit had died and some leaves had fallen. The tip wood tissue was also dead and the affected tips were hanging down. The recordings were as follows:

- (i) One branch with brown dead leaves at the tip: trees 8, 9, 62, 63, 118, 121, 126, 129, 140.
- (ii) Two branches with brown dead leaves at the tips: trees 7, 30, 49, 55, 69, 71, 116, 123, 144.
- (iii) Three branches with brown dead leaves at the tips: trees 29, 48, 68, 70, 101.
- (iv) Four branches with brown dead leaves at the tips: tree 100.

- (v) Trees with complete branches of brown, dead leaves: trees 23, 53 (1/5); 28, 80 (2/5); 27, 61 (3/5); 20, 46, 93 (4/5); 36 (2/6); 47, 79, 92 (3/6); 44 (4/6).
- (vi) Trees with dead branches devoid of leaves: trees 87 (3/4); 59 (4/5).
- (vii) Completely dead trees with no leaves: trees 11, 12, 21, 22, 37, 38, 39, 45, 54, 60, 78.

On the fourth visit seven weeks after the strike a number of affected trees were showing signs of recovery with the production of vigorous young leaf flush. Tree 44 was completely defoliated and dead. Recovering trees were recorded in three groups as follows:

- (i) Vigorous young flush and shoots at the jorquette: trees 8, 20.
- (ii) Vigorous young leaf flush on branches: trees 27, 61, 68, 69, 118, 121.
- (iii) Vigorous young leaf flush and shoots on the trunk: trees 36, 79, 87.

On the fifth visit, 19 weeks after the strike, the previously surviving cacao trees had all recovered and had started to produce flowers and young cherelles. There was no evidence of delayed effects leading to later deterioration of trees not severely affected during the first 3 weeks. At 32 weeks after the strikes, the cacao trees alive on the third visit had all produced new growth.

Leucaena leucocephala

Although the *L. leucocephala* shade trees in the affected area were taller than the cacao trees, only three were found to have been affected by the strike. On the first visit none of the leucaena trees showed symptoms, but 1 week later tree number 10 was completely defoliated and the green seed pods were shrivelled. Tree 11 was defoliated on the branches nearest to coconut B and the remaining branches had normal healthy leaves. Tree 5 had lost the leaves on the branches closest to coconut A. None of the other leucaena trees was affected.

On the third visit, tree 10 was dead and tree 11 had inadvertently been stumped. Tree 5 was showing the same amount of defoliation as

recorded on the second visit. After seven weeks there was no change in field symptoms or recovery by affected trees. On the final visit tree 5 had new vigorous growth, but the branch which had been defoliated was dead.

As with the cacao, there was no evidence after the initial period of three weeks of delayed effects amongst the leucaena trees.

CONCLUSIONS

Although observations were made for only 8 months after the initial strike, there was no evidence at the final recording of delayed symptoms on coconut palms as described by Charles (1960). The strike observed may have been less severe than that observed by Charles or the effect may have been dissipated through the cacao and

leucaena trees, or both. The foliage symptoms on cacao resembled those induced by heat from fires under trees. There was no evidence at the final recording of delayed symptoms on the cacao and leucaena trees.

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