Of Cabbage Trees and Rhododendrons

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Introduction

In Robinson (1994) I reported the results of seven years of recording the flowering behaviour of cabbage trees, *Cordyline australis* (Forst. f.) Endl. (Agavaceae) in west Christchurch. Trees are observed along a fixed route, and the number of inflorescences is estimated from what can be seen from the street. This paper reports the 1994 census, updates the table and reports progress on the conjecture about patterns of flowering in consecutive years by particular trees. We also see that in certain respects the architectures of cabbage trees and rhododendrons are very similar.

1994 Census

This was a very good year for cabbage tree flowering, with 90% of the mature trees observed in flower, the best since 1989; it was also a good year for first flowering of young trees, the five observed being the most since 1988. Table 1 shows the updated statistics. The date 'anthesis' is the date of flowering of trees in my own garden. This was not recorded in 1993, but is estimated from the flowering of a paeony, which was noted, and which consistently flowers up to six days after the cabbage tree, with an average of about three days afterward.

The table shows that 1994 ranks with 1987 and 1989 in terms of the percentage of adult trees flowering, but exceeds them both in the number of trees flowering for the first time. Indeed, the only comparable year for first flowerings was the otherwise very poor, but very early, year 1988.

Flowering Cycles

The hypothesis was advanced in Robinson (1994) that some trees flower heavily in alternating years, while others show a three-year cycle. This looked unlikely to be confirmed when a tree (D14w) in my own garden, which was showing a pattern of heavy flowering in odd years only, in 1994 equalled its greatest flowering ever. However, of the 12 trees observed in each of the last six years, five are still showing the alternating pattern, three being heavy flowerers in even years and two heavy in odd years. As chance would give about one tree with maxima in alternate years in a sample of 12 (depending on the probability model used), there is still strong statistical support for the hypothesis of a tendency in some trees to alternate their flowering. But other trees have different patterns.

To make progress in explaining the observations, it is necessary to look at the flowering pattern in more detail. Figure 1 shows the flowering cycle of a cabbage tree.

Most inflorescences are terminal on their shoots. If this were invariably the case, a tree at first flowering would product a single inflorescence, as I stated (twice) in the 1993 paper, but this year one of the first-flowering trees apparently had three inflorescences. It is possible that this was due to damage to the terminal bud, but it is also possible that lateral buds can develop into inflorescences in particularly favourable years. I have seen a pair of inflorescences on an older tree which suggests that this can happen.

After flowering, lateral buds at the base of the inflorescence develop into new shoots, which eventually develop a new terminal bud and subsequently bloom, completing the cycle. Frequently only one lateral bud develops. The branch then continues single, but the remains of the inflorescence generally hang on the tree for another year, and fragments may last longer. If sought out it can be seen that the scar of the attachment of an inflorescence lasts for many years.

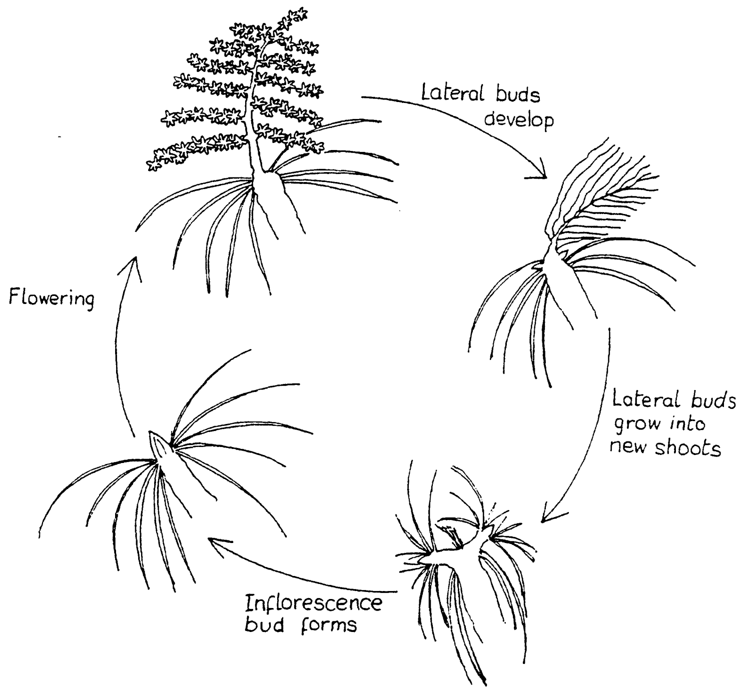

Fig. 1 The *Cordyline australis* flowering cycle

Sometimes more than one lateral bud develops, resulting in two or even three branches instead of one. Occasionally, the terminal bud may die and no new lateral buds be formed, resulting in a dead branch.

It is evident that some shoots flower in the year after they are formed, and some not until at least the second year. If all shoots took two years to reach flowering, this could result in the observed alternate year pattern. A question then is whether the length of time to flowering is determined at the time the bud is formed or later in the cycle.

To answer this question it is necessary to consider trees more closely than just counting inflorescences. Counting non-flowering shoots as well would help, but best of all would be to follow the history of the individual branches of a particular tree. In my garden I have, besides the tree D14w mentioned earlier, a younger tree D14s which flowered for the first time in 1988, and whose history is therefore known. Fortunately D14s is not very tall and it was possible by means of a ladder to reach the crown. It proved quite easy to record the scars. The result is shown schematically in Fig. 2. The first result of comparing the scars with the record is that ten inflorescences were recorded before 1994, but there are 15 scars. One scar takes a form different from the others, a short stump and no fibrous tuft. This seems to have been a terminal bud that died, whose place was taken by a lateral shoot. Somehow there were four inflorescences that were not recorded.

Knowing the year of first flowering of the tree and the number of inflorescences each year, we see at once that no branch can have flowered every year, since no branch has a long enough sequence of scars. On the other hand the counting reveals that most shoots must flower the year after they are formed. It may be significant that there are no shoots this year which are not flowering, so there appear to be no shoots caught in the middle of a two-year cycle. But this is a maximum year for flowering, and D14s is not an alternating year tree. There are, even this year, some trees which have no inflorescences at all, so all their shoots are in an 'off' year. These trees tend to be sickly or overgrown - one is smothered in ivy - so development will be slower than for most trees.

Thus trees in which most shoots take two years to reach flowering may show an alternating pattern. However, a very suitable year may result in many shoots reaching maturity and flowering in one year, thus disrupting the cycle. The next year there will be fewer than usual two-year old shoots, so a poor year will follow for that tree, re-establishing the cycle. On the other hand a poor year generally might delay some inflorescences to a third year: the year following a poor year will be a very good year for such a tree.

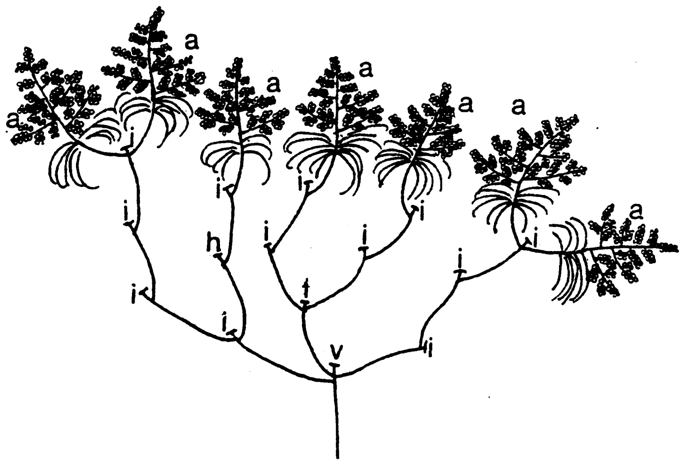

Fig. 2 Schematic of the branching of the tree D14s
a - 1994 inflorescence; v - remains of 1988 inflorescence; h - remains of dead terminal shoot; I - remains of inflorescence, 1989 - 1993

Of Rhododendrons

In an example of parallel evolution, I also have in my garden a specimen of the *Rhododendron* (Ericaceae) cultivar 'Sappho', which shows a similar pattern. Figure 3 shows the structure of part of this shrub. Comparison with other *Rhododendron* cultivars shows that the pattern is common to many members of the genus, though some are not so close to the *Cordyline australis* structure as this. The inflorescence is again terminal, in this case a simple raceme, which rises from a terminal bud as the first growth of the new year. Just below it is a ring of the previous year's leaves, from the axils of a few of which spring new shoots after flowering to repeat the cycle. Again, shoots may flower the next year, or the terminal bud may do another year's vegetative growth. The parallel even extends to the retention of the remains of the previous year's inflorescence. As an experimental plant *Rhododendron* has several advantages. You don't have to climb a ladder to observe it, and the ring of leaves clearly marks the end of the year's growth. In some species there can be lateral shoots from the axils of this ring, but they have not been observed in this specimen. As the schematic shows, on a shoot which is not flowering this year, the new growth occurs at the same time as flowering, but there had been no growth from axils beneath inflorescences by the time the schematic was drawn. The only snag seems to be that buds sometimes remain dormant for a whole year before making a shoot.

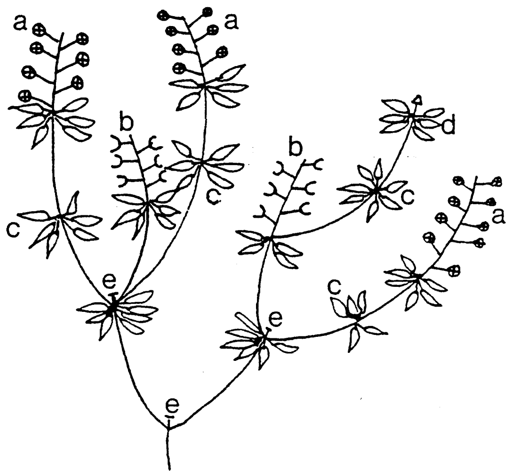

Fig. 3 Schematic of *Rhododendron*, cultivar 'Sappho"
a - 1994 inflorescence; b - remains of 1993 inflorescence; c - ring of leaves from a non-flowering year; d - ring of leaves from early 1994 growth on a non-flowering shoot; e - remains of inflorescence, 1991 - 1992

CONCLUSIONS

The schematics show that the tendency for there to be close correspondence between features of unrelated plants extends to branching structure, with a relationship between the dicot *Rhododendron* and the monocot *Cordyline*.

The only mechanism so far suggested by which some trees might have alternating years of heavy and light flowering is that for these trees most shoots take two years to flower, but there is as yet no direct evidence that this is what happens.

Reference

Robinson, D.F. 1994. The flowering of cabbage trees (*Cordyline australis*) in Christchurch, 1987-1993. *Journal of the Canterbury Botanical Society 28*: 47-50

Table 1. Flowering statistics 1987-1994

YEAR	1987	1988	1989	1990	1991	1992	1993	1994
Anthesis		Oct 25	Nov 9	Nov 12	Nov 10	Nov 20	Nov 1[1]	Nov 13
Census	Nov 17	Oct 28	Nov 13	Nov 27	Nov 22	Nov 27	Nov 16	Nov 15
Juvenile	8	11	5	8	12	15	12	11
First Flowering	0	5	1	1	1	0	2	5
Non-flowering	4	19	4	12	19	13	11	6
Flowering	39	30	68	38	38	56	53	52
All trees	51	65	78	59	70	84	78	74
Adult total	43	49	72	50	57	69	64	58
% flowering	91	61	94	76	67	81	83	90
Mean inflor[2]	6.0	2.3	7.0	3.9	4.3	4.9	5.4	6.4

[1] Estimate from paeony flowering

[2] Mean number of inflorescences per adult tree