Short Communications / Kort Mededelings

Smoke-induced flowering in the fire-lily *Cyrtanthus ventricosus*

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Flowering of certain fynbos geophytes has long been noted to have an obligate dependence upon fire. One of these species, *Cyrtanthus ventricosus* (Jacq.) Willd., is shown here to be stimulated to flower by smoke. Ethylene, a gaseous component of smoke, did not stimulate flowering in this species.

Dit is lank reeds bekend dat blomvorming by sekere fynbosgeofiete 'n verpligte afhanklikheid van vuur het. Daar word hier aangetoon dat een van hierdie spesies, *Cyrtanthus ventricosus* (Jacq.) Willd., deur rook gestimuleer word om te blom. Etileen, 'n gaskomponent van rook, het nie blomvorming by hierdie spesie gestimuleer nie.

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Fire-lilies such as *Cyrtanthus ventricosus* (Amaryllidaceae) are one of the most unique features of fynbos vegetation. While fire-prone ecosystems in other mediterranean-climate regions have species with fire-stimulated flowering, fynbos fire-lilies exhibit a remarkably close association with fire. Commonly within days of a fynbos fire, these geophytes will initiate flowering. It is noteworthy that flowering can be initiated at any time of the year, being keyed entirely by fire (Tompsett 1985; Olivier & Werner 1980; Le Maitre & Brown 1992). Most authors report that flowering is essentially non-existent in the absence of fire and this degree of specialization is probably not known in other fire-prone vegetations. Because of this close association to fire, some of these otherwise attractive geophytes are extremely difficult to utilize in cultivation (Oliver & Werner 1980).

It is unknown what environmental cues will induce flowering in fire-lilies. Potential cues include direct and indirect factors. Direct effects of fire are intense heat shock or chemicals from smoke and charred wood. Indirect effects of fire are increased nutrients and elevated soil temperatures on burned sites. For some geophytes it appears as though indirect effects are likely cues for flowering (Le Maitre & Brown 1992). However, in the light of the strict association of flowering and fire observed in *Cyrtanthus ventricosus*, indirect factors seem less promising of an explanation. This would be supported by the extreme difficulty in obtaining flowering of such species in cultivation. Tompsett (1985) hypothesized that smoke contained various gases, such as ethylene, that may stimulate flowering in *Cyrtanthus ventricosus* and other fire-stimulated geophytes. This is suggested by the observation that smoke and ethylene treatment of various commercially important bulb species affect flowering behaviour. Although none of these studies have demonstrated that smoke or ethylene can induce a qualitative switch from dormancy to flowering, they have shown that these gases can speed up the timing of flowering and final percentage of flowering (e.g., Imanishi 1983; Imanishi & Fortanier 1982/83).

Experiments were set up to test the hypothesis that smoke and ethylene are the cues that induce *Cyrtanthus ventricosus* to switch from dormancy to flowering.

In late spring (November) 1990, approximately 10 bulbs of this species were collected from flowering plants on a very recently burned site north-west of Caledon in the Cape Province of South Africa. They were planted in a sandy-loam planting bed in full sunlight in Los Angeles (USA) and were maintained for a little over 2 years, during which time they remained in a vegetative state, producing a couple of leaves each spring (February – May). In mid-spring (March 1993) a single bulb was planted in each of eight 1-gallon pots of sandy-loam soil. These were maintained in full sunlight for at least a month. The experiment consisted of three treatments, each applied to two pots in separate chambers. In one treatment, smoke from burning pine sawdust heated on a hot plate was transferred through an 80-cm hose into the chamber and this was continued for approximately an hour. During this time the chamber temperature never exceeded ambient room temperature of approximately 25°C and the pots were incubated in this smoke-filled chamber for 24 h. By the end of this treatment all leaves had withered. In a second treatment, plants were incubated for 48 h under 100 p.p.m. ethylene. At the end of this treatment, leaves were still intact. In a third treatment, leaves were cut off at ground level prior to incubation for 48 h under 100 p.p.m. ethylene.

All treated pots and the two control pots were placed in the sun and watered daily. Within 3 days a flowering stalk emerged from each of the smoke-treated bulbs and after a total of 10 days they were in full flower. After one month the two control pots and the four ethylene-treated bulbs still had not flowered.

Although this experiment was of limited size owing to difficulty in obtaining further experimental material, the results are intriguing. In the light of the extreme difficulty in inducing flowering of this species in cultivation, it seems likely that flowering initiated in the bulbs treated by smoke is probably not just a coincidence. Apparently, ethylene does not appear to be the active component of smoke and further tests are needed with other gaseous components of smoke.

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