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Peculiar Mode of Propagation in a *Crinum yemense* Defl. (Amarylldaceae) Population in Saudi Arabia

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ABSTRACT. A peculiar mode of propagation in a population of Crinum yemense Defl. from the mountain range (2150 m.a.s.l.) in Al-Bahah District, Saudi Arabia was investigated and described in the present work. The ovary apparently lacks ovules and develops into a sub-aspherical to spherical propagule containing a single bulblet which, probably, originates as an embryo from the ovary wall. Should more than one embryos developed, then only one survives. The bulb increases in size at the expense of food stored in the propagule; emerging from the propagule, its basal end produces contractile roots. The leaves are produced later from the top end which is the last stage of development of the propagule.

Introduction

The Sarawat mountain range (400-2400 m.a.s.l.) in Al-Bahah District, Saudi Arabia known for its variable topography, climate and natural vegetation (Zahran, 1983; Hajar, 1991; Hajar *et al.*, 1991, Hajar, 1993 and Hajar *et al.*, 1996). On the slopes of the Sarawat mountains (above 1500 m.a.s.l.) the most common community type found is the woodlands of *Juniperus excelsa* M. Bieb (Hajar, 1991 and Hajar *et al.*, 1991). These woodlands have a large number of plant species (Hajar, 1993) including *Crinum yemense* Defl. (Hajar *et al.*, 1996). *C. yemense* is patchily scattered in these ranges. The Sarawat mountain extending south into Asir region then into Yemen from where this species was first described (Schwartz, 1939). In the present study this species is mostly restricted to the Juniper Zone in woods above 2000 m.a.s.l. During an ecological field study in late November (1994), it was observed that the time of the falling off the

mother plants of *C. yemense* was also the time of the caducity of the fruits. The rigorous field observations revealed no other type of fruits or seeds, which may enable the plant to produce a new recruits. The present study was therefore carried out investigate these peculiar fruits.

Material and Methods

Fruit collection

The recent fruits of *C. yemense* were collected from the underneath of *J. excelsa* canopy. The site of collection was the Al-Rahwah woodland, slopes, on Al-Sarawat mountains, 10 km south east of Al-Bahah city (2150 m.a.s.l., Lat. 20°18′, Long. 41°26′). The fruits were brought to the National Agriculture & Water Research Center (NAWRC) then left in assuming that the fruits and therefore the assumed seeds inside them had a delayed maturity and that in time the fruits would dry up, and dehisce and release the seeds which by then would have mature.

Fruit description

The fruits of *C. yemense* are turgid globose with a whitish to light brown thin outer skin, a bluish-green succulent material could be seen beneath the skin wherever the latter happened to be broken (Fig. 1). These globose fruits were found scattered, and after rolling down the slopes for various distances, lodged in small hollows or amongst rocks down-slope in plant litter from Juniper trees and other plants in the wood. The blue green main body of the fruit, when visible through broken skin, was tacky to touch.

FIG. 1. Three propagules of *Crinum yemense* Defl.

Plant propagation

When the fruits did not show any sign of maturing by drying up or shrivelling at room temperature, one of these was cut open (Fig. 4, right bottom). The fruit was observed to consist of a fleshy mass of tissue throughout and enclosing a single "embryo" without any sign of the expected three ovary-chambers, or the seed-coat or a point of attachment. The "embryo" itself appeared as a bulblet in a vertical section through its central, main body. Cutting up a few more of the fruits revealed the same phenomenon. It transcribed that the fruits themselves, rather than any conventional seed in them were the propagules (as they will be referred to so from now onwards in the present paper). The rest of the propagules were then placed and maintained on top of a potting mixture (sand: peatmoss, 2:1) in 20 cm diameter perforated plastic pots in a greenhouse, under direct 14 hours sunlight. The propagules did not show any prominent shrivelling till the embryol bulblet started emerging from the propagule as a loop first and then the basal end (Fig. 2). The bulblet, by then a bulb, ultimately produced roots

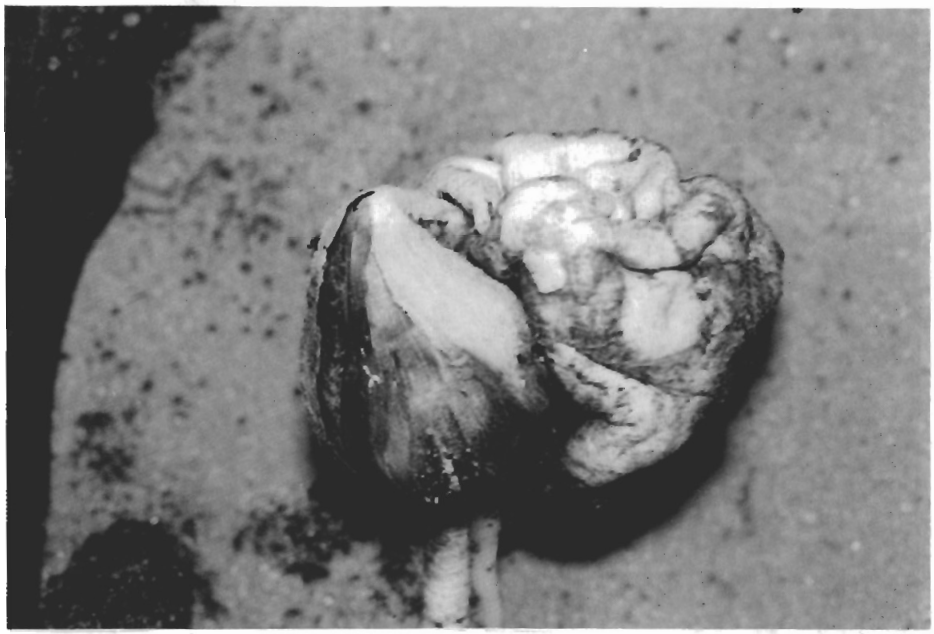

FIG. 2. Bulb emerging out of a propagule. Wrinkled surface of the root in the foreground shows its contractile nature.

from the basal end and got established in the soil. The root surface through smooth to begin with, appeared wrinkled indicating the contractile nature of the roots (Fig. 3). Meanwhile the bulblet/bulb remained connected to the propagule as its other end through an elongate narrow structure while the propagule shrivelled to a hollow, papery remnant, apparently, after translocation of all of its food reserves to the bulb (Fig. 4, top right). The latter had kept on increasing in size without having developed any exposed green leaves except for some green area in one of the outer leaf-bases (Fig. 2 & 3). At

FIG. 3. Bulb in the process of getting established but yet still attached to the parent propagule.

FIG.4. The shell of a propagule after the establishment of the bulb that it nourished (top right): the propagule with the bulblet embryo (bottom right): the bulb in a vertical section before development of foliage leaves (middle): the bulb with the foliage leaves (extreme left).

this stage all that remained of the propagule was the shell consisting of the outer layer which look no more than a thick white paper. The bulbs developed into healthy young plants doing well in the greenhouse at the time of writing of this report (Fig. 4, left).

Herbarium material

The herbarium material collected at the time of the field visit was left for more than one year, then investigated. The umbels consisted of 8-18 flowers per inflorescence. It was observed that ovaries of 1-3 flowers per umbel appeared to have been developing or showed signs of having been developing into the propagules at the time of collection. The other flowers were "sterile" – looking and had dried black in contrast to the light brown or whitish appearance of the potential propagules. After soaking in water after a brief dip in rectified spirit, the sterile ovaries would easily disintegrate and had to be cut very carefully with a sharp razor blade. These showed a lot of bundles/fibers and hardly any sign of septation or ovules. Two of the three potential propagules tolerated the short dip in alcohol very well, and later soaked up water and appeared firm. Before dipping in water, these had a shrivelled appearance after having been dried in a plant pressed between newspapers and blotters (no artificial source of heat was used) and kept between newspapers and blotters fore more than one year. The three potential propagules were carefully dissected for study. The propagules consisted of a mass of firm, living tissue. One of the propagules contained a sigmoid embryol bublet embedded in a whitish glistening tissue and without any apparent attachment to the walls of the propagule. The second propagule contained one similar sigmoid embryo in the apical portion of the potential propagule but in a separate cavity. The third, dried up, potential propagule had a blackened dead median mass suggesting presence of an embryo.

Discussion

A literature search has not shown any reference on the subject concerning propagule formation replacing regular sexual reproduction/seed formation in *Crinum yemense.* However Verdoom (1973) reviewed on the peculiarity of seed germination of the genus *Crinum* in southern Africa.

The climate of Al-Sarawat in general and Al-Bahah in particular is semi arid (Hajar, 1993), though receiving significantly higher (but erratic) rainfall than other parts of Saudi Arabia. At higher elevation (about 2000 meters and above), vast areas of the region supported and even now support juniper (*Juniperus excelsa*) forests especially on west-facing slopes. A very important feature of the climate is the exposure of the west-facing slopes to moisture laden air blowing in from the Red Sea in the west. The atmospheric humidity is of tremendous importance for survival of established plants but may not be enough to meet the moisture requirements for germination of seeds of some plants (*e.g. C. yemense*). The production of the propagules here has an adaptive value. Apparently, no animal eats the propagules. The bulblets develop at the expense of the food stored in the propagules till the establishment of the bulb in the ground. After falling off the mother plant, rolling down of the propagules into depressed spots down a slope ensures a relatively better availability of moisture to plants of *Crinum yemense*, while also affecting dispersal over a wider area.

It is obvious that a lot more needs to be studied concerning reproduction in the Al-Bahah and other populations of *Crinum yemense* in the Arabian Peninsula. The report is meant to bring to the attention of scientists one of the innumerable mysteries awaiting exploration in the flora of Saudi Arabia. Also, it is pointed out that no comparative study was made on the mode of germination in other species of the genus *Crinum*. But we assume that possibly some of the other *Crinum* species too might possess a similar mechanism.

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أسلوب فريد للتكاثر في مجتمع نبات الكرينم *Crinum ye-mense* (Defl.) في المملكة العربية السعودية

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المستخلص. لوحظ تكاثر فريد وغريب في مجتمع نبات الكرينم النامي في المرتفعات (٢١٥٠م فوق سطح البحر) بمنطقة الباحة. وقد جرى تقصي هذه الظاهرة ووصفها في هذا البحث. حيث لا توجد بويضات بالمبيض، الذي بدوره يتطور إلى عضو تكاثري كروي أو شبه كروي يحتوي على بصيلة ربما تكونت على شكل جنين من جدار المبيض. وفي حالة تكون أكثر من جنين فإنه لا ينجح إلا واحد في الإنبات. ولوحظ أن البصلة تزداد حجمًا على حساب الغذاء المخزن في العضو التكاثري وأما أسفل البصلة فإنه ينتج جذورًا حلزونية شادة. وبعد ذلك تخرج الأوراق من قمة البصلة ومن ثم تنمو وهذا آخر مراحل بداية نمو نبات جديد.