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Hydnora triceps (Hydnoraceae) - First record in Namibia and first description of fruits

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Abstract

Hydnora triceps *is a rare parasitic angiosperm growing on the roots of* Euphorbia dregeana*. It is a poorly collected and studied species due to its furtive nature and problems with the preservation of dried material. It was thought to occur only in a small area in the northwestern Cape region. This paper reports on the discovery of* H. triceps *near Rosh Pinnah in southern Namibia, with some notes on its floral biology. A description of the fruits and seeds found in the Port Nolloth area is also included.*

Keywords: parasitic angiosperm, root holoparasite, hypogeous flowers and fruits

Introduction

Hydnora is a genus of holoparasitic flowering plants growing on the roots of mainly *Euphorbia* and *Acacia* species. It is almost entirely African in distribution, with some reports from the Arabian peninsula (Visser & Musselman, 1986). Being holoparasitic, it is completely without chlorophyll and totally dependent on its host for water, minerals and organic compounds (Visser, 1981). The plant body is extremely reduced to roots and buds, with no leaves or even leaf-like structures. These plants spend their entire life below the soil surface, and only emerge to flower.

Currently four species are recognized - *H. esculenta*, *H. johannis* (= *H. abyssinica* = *H. solmsiana*), *H. africana* and *H. triceps* (Musselman, 1991). While *H. esculenta* is restricted to Madagascar, *H. africana* and *H. johannis* are fairly common in Namibia.

Hydnora triceps Drege et Meyer was described in the 1830's by Drege from the Okiep area in northwestern Cape and was thought to be extinct until its rediscovery by Johann Visser in 1988 who found a large population of these remarkable plants on the farm Droëkraal between Springbok and Port Nolloth (Visser, 1989). Based on the limited distribution of the host, the northwestern Cape was assumed to be the only location in the world where *H. triceps* occurs. It has only been collected a few times since its discovery almost 170 years ago and remains a poorly known plant, largely

due to the fact that it never appears above the soil surface - contrary to the other species, even the flowers of *H. triceps* remain underground.

Materials and methods

Field observations were conducted during September 2001 in the Port Nolloth and Rosh Pinah areas, localities where the host is known to occur (the only other known location of the host is in the Sperrgebiet where, being a diamond area, access is severely limited). Having found fresh flowers during this visit, we postulated that fruits would mature near the end of the year. We thus returned to the Rosh Pinnah sites in late December 2002 to locate fruits as none has ever been described.

Voucher specimens of the material collected from southern Namibia and Port Nolloth have been deposited in the National Herbarium in Windhoek (WIND).

Because *Prosopanche*, the only other genus in the family Hydnoraceae, exhibits a chamber flower pollination syndrome (Coccuci & Coccuci, 1996), an attempt was made to determine changes in flower temperature at sunset. A thermocouple was inserted through one of the vents in two flowers at anthesis to determine if there was any significant difference between flower and ambient air temperature. Unfortunately, because of the poor condition of the road, we only arrived at the site about half an hour after sunset.

Observations

During September 2001, a total of five *H. triceps* populations were located along a stretch of road starting at the Lekkersing / Eksteensfontein turnoff about 30km from Port Nolloth on the main road to Steinkopf and extending some 35km onto the Wolfberg dirt road leading to Spektakelberg. Based on Visser's field notes, we could identify one of these populations as the original population discovered by him in 1988. At all of these sites, we found buds and flowers at various stages of maturity, as well as a single immature fruit still attached to the flower.

Hydnora triceps is always associated with what seems to be the exclusive host, *Euphorbia dregeana* E. Meyer ex Boiss. - a shrubby *Euphorbia* restricted to this area in Namaqualand and southern Namibia. Despite the occurrence of a number of other *Euphorbia* species (including *E.gregaria* and *E.gummifera,* documented hosts of *H. africana*), no signs of parasitism by *H. triceps* could be found on any of these species.

Euphorbia dregeana (locally known as the "dikloot melkbos"), is a tall, spineless shrub with thick, non-segmented branches radiating from the bottom (Figure 1). The

flowers have large yellowish bracts and are borne in short terminal umbels. The fruits are yellow-green capsules turning reddish-pink when ripe.

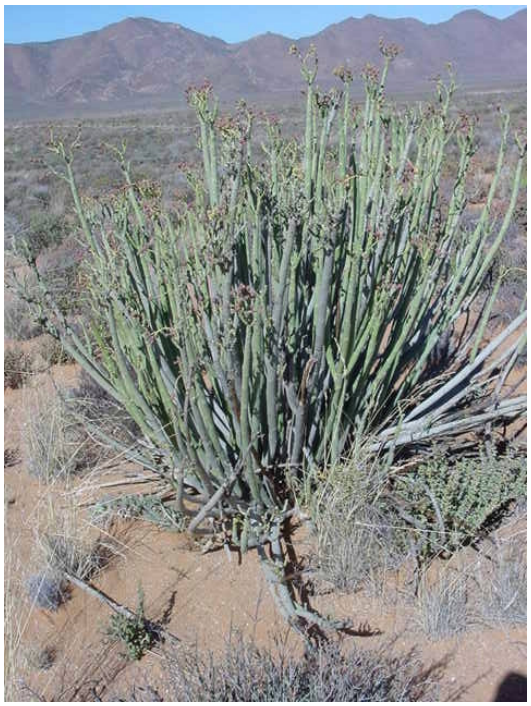

Figure 1: *Euphorbia dregeana* - exclusive host for *Hydnora triceps*.

Although restricted to a small area on both sides of the Orange river, it is very common in the areas where it occurs. Its distribution seems to be patchy, with dense stands separated by stretches of several kilometres wide without any specimens. In these stands, an estimated 10% of all of the *E. dregeana* plants appeared to be parasitized by *H. triceps*, although it is impossible to tell which parasites belong to which host because the connections are all subterranean.

Encouraged by the findings in the Port Nolloth area, we set off to southern Namibia. Large populations of *Euphorbia dregeana* were located on the farm Namuskluft in the Rosh Pinnah area, but it was only after an extensive search that Libby Musselman spotted the first *H. triceps* flower on Namibian soil, about 300m along the path to Namuskluft farmhouse (27° 59' S, 16° 47' E). Despite more hours of relentless searching over three days, only three more flowers (one with an immature fruit attached), were found. The *H. triceps* population in southern Namibia appears to be far smaller than those found in northwestern Cape - less than 0,5% of the potential hosts observed, showed evidence of parasitism.

On the farm Namuskluft, a single old flower of *H. africana* was also found, presumably parasitizing *E. gummifera*, the only potential host besides *E. dregeana* in the area. This is the first record of *H. triceps* and *H. africana* occurring in the same area.

All the *Hydnora* sites showed signs of extensive mammal activity and it is assumed that the fruits are eaten, and the seeds distributed, by small mammals living in the area. This idea was strengthened by our observations in December 2002 when we

found about two dozen fruits, most of which were hollowed out by some unknown animal (Figure 2). Contrary to our initial thinking, the fruits were not dug up and uprooted from the soil - rather, the edible parts containing the seeds were scooped out, leaving the empty shells still in place below the soil surface. More field observations are necessary to determine the type of mammals involved and methods of seed dispersal.

Figure 2: Fruit of *Hydnora triceps* eaten by an unknown mammal.

Description

The plant body of *Hydnora triceps* is remarkably reduced and no stems or leaves can be distinguished, only a well developed system of what has been termed pilot roots - rhizome-like structures traversing the soil. These pilot roots are typically 2–3cm in diameter and angular in shape with rows of protuberances. It is dark brown in colour, but bright pink to red on the inside when fresh, and extremely astringent in taste.

Numerous flower buds grow from the pilot roots. These buds are characteristically fleshy, triangular in shape and white-yellowish in colour when fresh. Not all of the buds develop to maturity and one frequently finds a number of brown, dried buds (Figure 3) in various stages of development on the same pilot root. The mature flower is tubular in structure with three perianth lobes fused to form a cap-like structure with three brightly coloured vents (Figure 4).

Figure 3: A young *Hydnora triceps* bud which failed to develop to maturity, still attached to the pilot root.

Figure 4: A mature flower of *Hydnora triceps*. Note the lateral openings leading to the inside of the flower.

Hydnora triceps appears to have a chamber flower - the androecium is fused into a complex antheral ring leading to a cushion-like stigma located at the bottom of a chamber below. This sub-antheral chamber varies from 2–10 cm in length. The flower rarely appears above the soil surface, and even in such rare cases, only the top

Figure 5: An immature *Hydnora triceps* fruit with the old flower still attached.

2 cm of the fused perianth tube protrudes, exposing a portion of the vents leading to the inside of the flower. It is far more common finding mature flowers up to 5 cm deep below the soil surface - the only indication of their existence being a crack in the soil and a characteristic fetid smell.

The fruit develops from the ovary below the sub-antheral chamber. In the immature state, the flower remains attached to the developing fruit (Figure 5). The young fruits found in September 2001 were about the size of an orange and weighed 225 g and 375 g respectively. It contained numerous white, immature seeds embedded in a white fleshy pulp.

The ripe fruits from Port Nolloth differ considerably in size - from about 3 cm to more than 10 cm in diameter (Figure 6). The fruits of *H. triceps* resemble those of *H. esculenta* (Jumelle & Perrier, 1912), *H. johannis* (Musselman & Visser, 1987) and *H. africana* (unpublished data).

Figure 6: Ripe, partly eaten fruits of *Hydnora triceps*, showing differences in size.

Each fruit consists of a tough, dark brown pericarp (between 1-10 mm thick), very astringent in taste, surrounding a white flesh with strands of small brown seeds (Figure 7). The pericarp is bright pink on the inside, but rapidly discolors when

Figure 7: A longitudinal section through the ripe fruit to show the strands of seeds.

exposed to air. The texture of the ripe fruit is like a very mealy apple, while the taste is slightly bland with a coconut overtone. A faint coconut odor was also noted. This is in contrast to the other described fruits in the genus which have rich, fruity odors and a delicious taste.

When ripe, fruit dehisce slightly at the apex (Figure 8), providing access for small mammals to scoop out the seed-containing flesh. It is not known what attract the animal to the subterranean fruits - it may be the odor of the ripe fruit. In some cases, the mammals removed the flesh before the fruit dehisced, by eating a hole into the fruit (Figure 9).

Figure 8: Ripe fruits beginning to dehisce at the apex.

Figure 9: Hollowed out fruit with old flower still attached.

Floral biology

Flower development could be followed by comparing flowers at successive stages of development. What was observed for the first time is the way in which the antheral ring closes as the flower matures (Figure 10). In the immature flower, the tri-lobed antheral ring is clearly smooth and waxy on the inside, with the pollen being formed in grooves on the outside. It seems as if the opening leading to the stigma in the chamber below, is still wide open when the stigma is receptive, although further observations are needed to verify this. As the flower matures, the opening to the chamber closes and pollen accumulates on a "pollen platform" formed by the constricting antheral ring.

Another interesting observation was the presence of a distinct secretory structure in the fold of each of the three perianth lobes. It is somewhat heart-shaped in structure and white and fleshy in the young flower, drying to become thin, papery and brown in the old flower (Figure 11). This osmophore could be the source of the rotten smell of the flower, and may serve to attract pollinators. If this is the case, it is situated in a rather odd position, out of the path from the opening to the stigma.

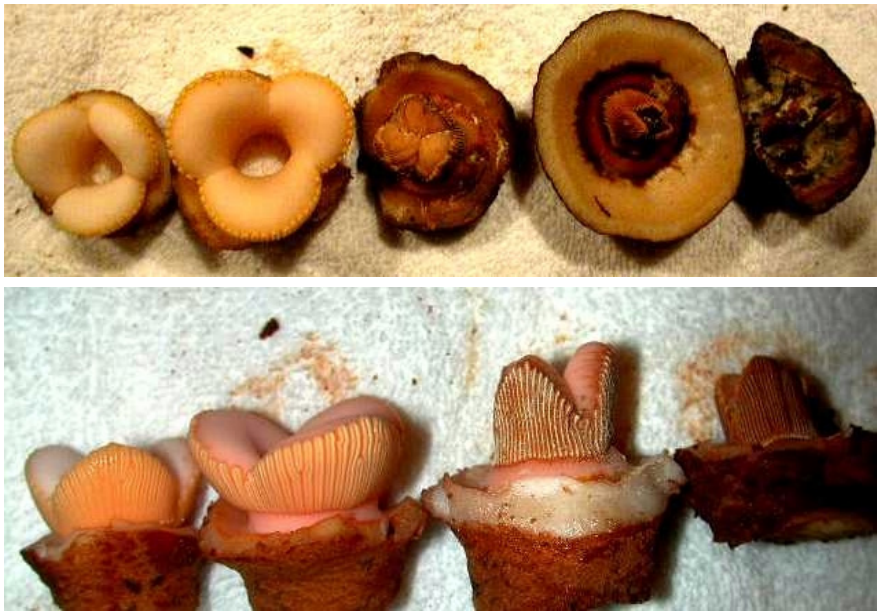

Figure 10: *Hydnora triceps* flowers with the perianth lobes removed to show the closure of the antheral ring as the flower.

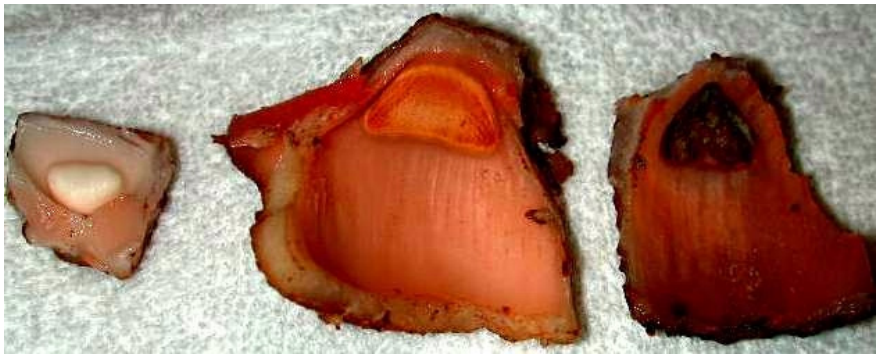

Figure 11: The development of the osmophore in the top fold of the perianth lobe.

We are still much in the dark as far as pollination is concerned. Almost all the flowers observed contained some insects, but more observations and field work are needed before any conclusions can be made.

No increase in flower temperature at sunset could be demonstrated, presumably because the readings were taken too late. If any, the flower temperature in both of the

two flowers measured, was slightly lower than ambient air temperature, something that could be explained by the fact that the flower is under the soil surface.

Acknowledgments

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