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Studies of diagnostic features in the genus *Hypoxis* L. (Hypoxidaceae R. Br.) on the Witwatersrand

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ABSTRACT

In an attempt to clarify specific concepts in the genus *Hypoxis* L. on the Witwatersrand it was found that diagnosis depends mostly on vegetative characters, particularly the habit, leaf vesture and venation, and the structure of the inflorescences.

The relevant criteria are discussed in relationship to the Witwatersrand species, where eleven species and seven varieties are recognized: *H. rigidula* Bak. (a) var. *rigidula*, (b) var. *pilosissima* Bak.; *H. acuminata* Bak.; *H. filiformis* Bak.; *H. obtusa* Burch.; *H. neliana* Schinz; *H. latifolia* Hook. f.; *H. galpinii* Bak.; *H. multiceps* Buch. ex Bak.; *H. interjecta* Nel; *H. rooperi* Moore; *H. argentea* Harv. ex Bak. (a) var. *argentea*, (b) var. *sericea* Bak.; and two varieties which constitute *comb. et stat. novs*, unpublished as yet.

RÉSUMÉ

ÉTUDE DES CARACTÈRES DIAGNOSIQUES DANS LE GENRE HYPOXIS *L. (HYPOXIDACEAE R. BR.) DANS LE WITWATERSRAND*

En tentant de clarifier les concepts spécifiques du genre Hypoxis *L. dans le Witwatersrand, on a constaté que la diagnose se définit surtout par des caractères végétatifs, particulièrement le port, la nervation et l'indumentation de la feuille, ainsi que de la structure des inflorescences.*

Ces critères sont appliqués pour la distinction des espèces du Witwatersrand, où onze espèces et sept variétés sont reconnues: H. rigidula *Bak. (a) var.* rigidula, *(b) var.* pilosissima *Bak.;* H. acuminata *Bak.*, H. filiformis *Bak.;* H. obtusa *Burch.;* H. neliana *Schinz;* H. latifolia *Hook. f.;* H. galpinii *Bak.;* H. multiceps *Buch. ex Bak.;* H. interjecta *Nel;* H. rooperi *Moore;* H. argentea *Harv. ex Bak. (a) var.* argentea, *(b) var.* sericea *Bak.; et deux variétés qui constituent* comb. et stat. novs *non encore publié.*

1 INTRODUCTION

Hypoxis L. is the type genus of the small family Hypoxidaceae R.Br. with distribution in the warmer regions of all the continents except Europe. In southern Africa it is well represented in the summer rainfall area, but absent in the flora of the Western Cape.

Quite recently (Walford, 1978), medical interest has arisen in certain *Hypoxis* species which were found to yield compounds useful in treatment of prostate cancer and of rheumatism. Further research is going on.

The genus was comprehensively treated by Baker (1878), and Baker's descriptions of the South African species were included in Flora Capensis (1896). The family was revised by Nel (1914). A partial revision of the Natal species has been recently carried out by Wood (1976, unpub.).

My studies were concerned with an attempt to clarify the specific determinations in the genus on the Witwatersrand. Here, for a few weeks in spring, *Hypoxis* is a dominant element in grassland; however, little is known about the genus. Before any taxonomic treatment, I had to gain information on population structures, life cycles, morphology and anatomy of the taxa. Then I was able to correlate these data with the accepted nomenclature available in literature and herbarium collections. In the present paper I want to discuss some of my findings.

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2 DIAGNOSTIC CHARACTERS

It soon became evident that in this genus diagnosis at specific level depends mostly on vegetative characters. The habit, leaf vesture and anatomy, and the structure of the inflorescences yield the most important criteria.

2.1 *Gross morphology*

The plants have a simple 'streamlined' appearance: a perennial corm with contractile roots and an annual complement of basal leaves and slender unbranched axillary peduncles. The leaves and peduncles emerge trifariously (1/3 phyllotaxis) from the corm apex.

2.1.1 *Rootstock. Hypoxis* corms generally do not form offsets. They grow vertically upwards, continuously pulled deep into the ground by their contractile roots. Above ground there is a single shoot.

In two Witwatersrand species, *H. acuminata* (Fig. 1A) and *H. galpinii*, the rootstock after a time spreads horizontally, forming short stolons. Each has a cormlike structure with a shoot at the apex. Above ground arises a tussock of several shoots, often as many as 20–40.

2.1.2 *Habit.* The length of mature shoots covers a range from 80–1400 mm. Three groups can be distinguished.

(a) Shoots spreading trifariously from the base. Here belong species with falcate leaves tightly stacked above each other in three ranks at angles of 120°: the large *H. rooperi* (Fig. 1B) and the small *H.*

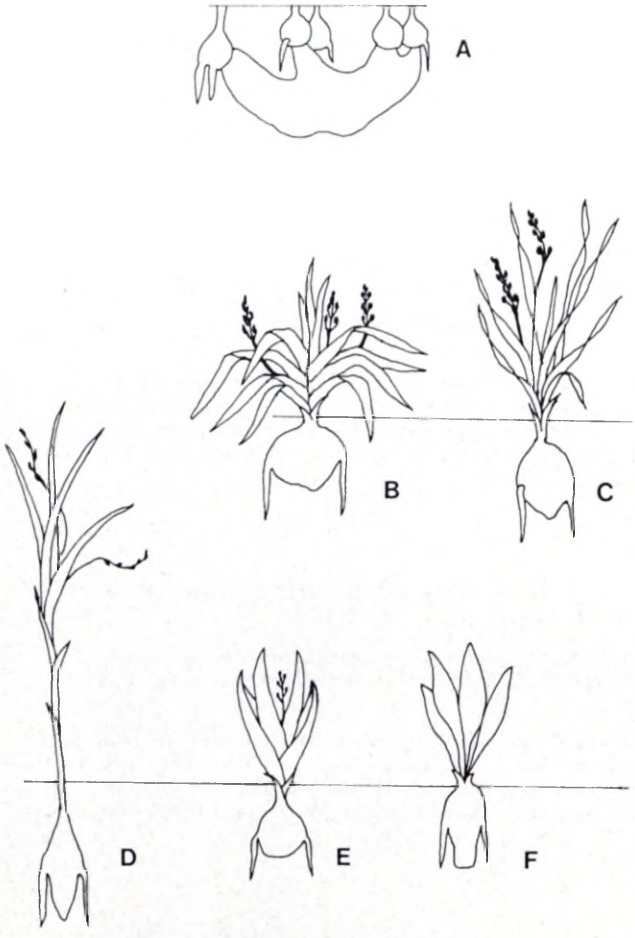

FIG. 1.—Branching rootstock. A, *Hypoxis acuminata* (× ½), trifarious habit; *H. rooperi* (× 1/5); C, *H. obtusa* (× 1/5), pseudostem; D, *H. rigidula* (× 1/5), funnel-shaped shoots; E, *H. galpinii* (× 1/5); F, *H. multiceps* (× 1/5).

argentea. Or shoots not so strictly trifarious, leaves not stacked, not falcate, but first recurved, and later in season spirally twisting upwards: *H. obtusa* (Fig. 1C).

(b) Leaves emerge from the ground in a trigonal leaf column sheathed by cataphyll bases so that a pseudostem is formed (Fig. 1D).

The pseudostems are as wide in diameter as the emerging leaves in *H. rigidula*, the tallest species in the genus, with pseudostems up to 200 mm long; the medium sized *H. acuminata* and the small *H. filiformis* in which the pseudostem is often absent.

In *H. neliana* the pseudostem is wider than the leaves, though it is only 10–20 mm long.

(c) Funnel shaped shoots. Leaves grow vertically upwards, only slightly separating from each other so that the shoot is wider above, in the shape of a funnel. In *H. latifolia*, a large species with leaves widest in the genus, leaves reach 100 mm in width. In the medium sized *H. galpinii* (Fig. 1E) the leaves when mature are connivent on the top.

In *H. multiceps* (Fig. 1F) and *H. interjecta* towards end of the season leaf bases narrow down and form pseudopetioles. The narrow pseudopetioles at the base and the wide laminae above produce a funnel effect.

2.2 *Vesture* (Fig. 2 A,C)

One of the basic characters of the genus is the presence of hair on all the aerial parts of the taxa. The trichomes are unicellular, but pluriseriate (Hummel & Staesche, 1962). That means that a single foot-cell in the epidermis may carry one simple hair, or one two-armed hair, or a stellate hair with 3–6 arms, or hair fascicled, with up to 18 arms.

2.2.1 *Hair orientation.* The hair may be appressed to the surface or patent. Patent hair produces woolly-effect on *H. rigidula* var. *pilosissima*, sericeous sheen on *H. argentea* leaves; densely fascicled hair on leaf margins forms white bands outlining the contours of the leaves in *H. obtusa* and *H. multiceps*.

2.2.2 *Hair topography.* On the inflorescences of *Hypoxis* hair is present in all species. The distribution of hair on the leaves varies. One Witwatersrand species, *H. interjecta*, has leaves totally glabrous. In *H. obtusa* var. *obtusa*, with the fascicled hair on margins, the leaf lamina is glabrous. In *H. rooperi* the lamina is densely covered with long hairs, but hair on the margins is sparse, fringelike. On the lamina of *H. rigidula* var. *rigidula* the hair is appressed in intercostal grooves; in *H. multiceps* it is found mostly above the veins. *H. filiformis* and *H. galpinii* have thin, sparse hair on the lamina and margins.

2.3 *Epidermis*

2.3.1 *Stomata.* The stomata of *Hypoxis* are mostly paracytic, but tetracytic in *H. argentea* and *H. galpinii*, and sunken in *H. filiformis*. The cuticle on subsidiary cells is smooth in *H. argentea*, outlined by a ridge in *H. rigidula*, *H. acuminata* and *H. neliana*, puckered in soft folds in *H. rooperi* and *H. obtusa* or covered by fine parallel striations in *H. multiceps* (Fig. 2B), *H. interjecta* and *H. galpinii*.

2.3.2 *Inclusions.* The taxa have many idioblasts with bundles of raphids, rodlike crystals of calcium oxalate monohydrate. In the epidermis of *H. filiformis*, *H. neliana* and *H. obtusa* var. *nitida* I found tetragonal crystals of calcium oxalate dihydrate, in short sequences over the veins. In *H. obtusa* var. *obtusa*, in the long parallel rows of epidermal cells over the veins, each cell contains such crystals. The leaves are stiff, coriaceous.

2.4 *Venation: leaf anatomy* (Fig. 3)

2.4.1 *Veins in transection.* The leaves of *Hypoxis* have parallel veins of uneven thickness, some very prominent. In transection they are seen as strands or girders (Metcalfe, 1960). The strands are small bundles of vascular tissue, surrounded by a bundle sheath. In girders the circumvascular sclerenchyma extends across the width of the lamina to the epidermis.

The strands are usually oval; they do not affect the leaf outline. The girders are T-shaped, rectangular or crescent-shaped. On the leaf surface T-girders protrude as wide, prominent ribs; the rectangular and crescent-shaped girders protrude only slightly.

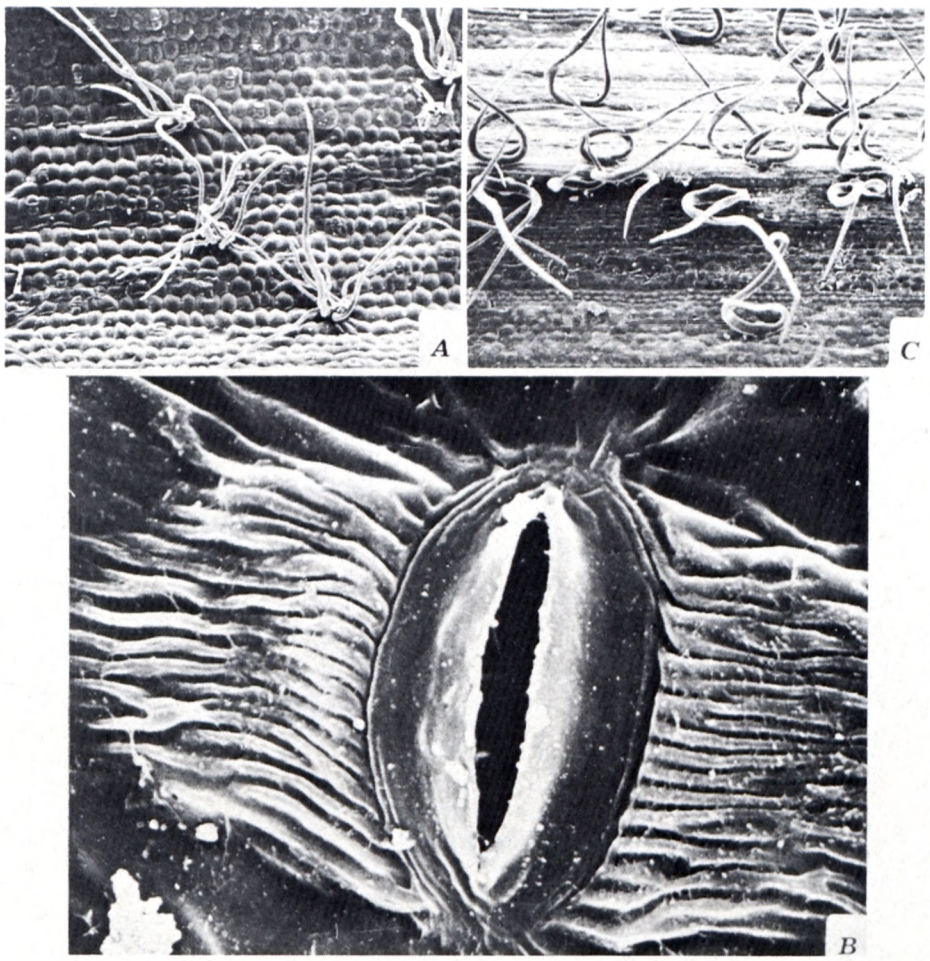

FIG. 2.—Hair: A, *H. multiceps*, stellate hair; C, *H. neliana*, two-armed curling hair (×50). Stoma: B, *H. multiceps* (× 1 500).

2.4.2 *Number and shape of girders.* Very prominent T-shaped girders characterize *H. rigidula* (14–20) and *H. acuminata* (5–6, submarginal).

Rectangular girders occur in *H. obtusa* (60–80), *H. neliana* (8–10), *H. multiceps* (24–50) and *H. interjecta* (24–40). They hardly protrude on the surface and are comparatively uniform in appearance. In *H. galpinii* (34–60) and *H. argentea* (4) two large girders are in quartile position, halfway between the keel and the margin: these girders are prominent only on the adaxial surface, and there the leaf shallowly folds back, the girder accentuating the fold.

Crescent-shaped girders are found in *H. rooperi* (30–48) and *H. latifolia* (12–15, very widely spaced). They alternate with strands in 1: 2 pattern.

2.5 *Structure of the inflorescences* (Fig. 4)

2.5.1 *The inflorescence.* The basic shape of *Hypoxis* inflorescence cannot be easily described by conventional terminology. Müller-Doblies (1977) defines it as a transitional stage between a rhipidium and a bostryx. The monochasial peduncles arise in leaf axils, in similar trifarious arrangement. In transection the peduncle is ancipitous, or flattened into a quasi rectangular shape, or crescent-shaped (canaliculate). On its upper part is a simple racemose inflorescence of pedicellate or rarely sessile flowers, each flower subtended by a bract.

2.5.2 *Flower arrangement.* The arrangement of flowers on the peduncle is an important diagnostic feature. Three types are distinguished:

(a) A slender sinuous ancipitous peduncle with alternate sessile or subsessile flowers. Flowers are spirally arranged, many, 2–18, *H. rigidula;* or few, 2–6, *H. acuminata,* or 4–11, distichously arranged, *H. galpinii.*

(b) In several species short erect peduncles bear flowers in pairs, in opposite arrangement. A two-flowered inflorescence resembles the letter Y, each flower on a long pedicel representing an upper branch of the Y, the peduncle forming the base. A four-flowered inflorescence has two Y-shaped tiers, one above the other, in decussate arrangement. Rarely a six-flowered inflorescence can be found, with flower pairs in three such tiers. The upper tier is sometimes reduced to one flower, forming a 3- to 5-flowered structure.

Peduncle slender, ancipitous; pedicels in each pair equal: 2–4 flowers, pedicels 10–30 mm, *H. argentea;* 2–5 flowers, pedicels 13–25 mm, *H. interjecta* and *H. multiceps.*

Peduncle stout, flattened; pedicels unequal: 1–3 flowers, pedicels 10–14 mm, *H. neliana.*

Peduncle slender, canaliculate; pedicels unequal, one flower usually sessile: (1)–2–(3) flowers, pedicels 0–14 mm, *H. filiformis.*

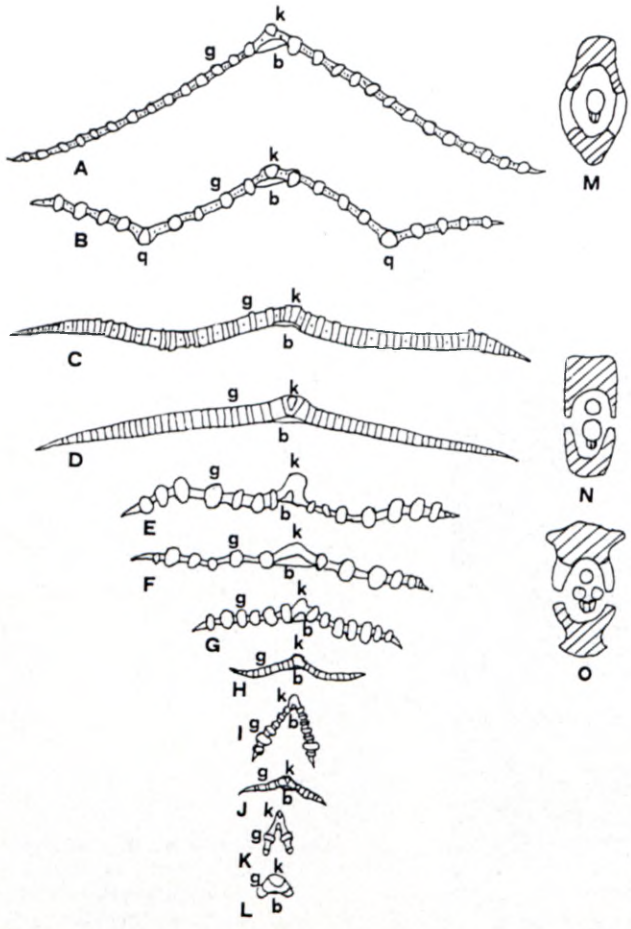

FIG. 3.— Leaf venation. A – L, leaf transections (× 3). A, *H. rooperi,* B, *H. galpinii;* C, *H. obtusa* var. *'nitida',* D, *H. obtusa* var. *obtusa;* E, *H. rigidula* var. *'hemerocallidea';* F, *H. rigidula* var. *pilosissima;* G, *H. rigidula* var. *rigidula;* H. *H. multiceps* and *H. interjecta;* I, *H. acuminata;* J. *H. neliana;* K, *H. argentea;* L, *H. filiformis.* M–O, fibrous girders (× 30): M, crescent-shaped (in leaves A, B, H); N, crossbar-shaped (in leaves C, D, J, K, L); O, T-shaped (in leaves E, F, G, I).

(c) Stout, flattened peduncles, with flowers in mixed sequences, the two lowermost opposite, the rest opposite and alternate, or in whorls of three. Flowers 5–13; pedicels 5–20 mm long, *H. obtusa;* flowers 4–13; pedicels 15–25 mm long, *H. rooperi.*

2.6 *Colour*

There is little interspecific variation in colour. In nearly all the taxa the corms exude yellow mucilage when sectioned; the aerial parts are green and dry beige-brown; the flowers are yellow.

However, there are solitary exceptions. The corms of *H. argentea* are white in section; the peduncles and pedicels in this species are tinged maroon. *H. rigidula* var. *hemerocallidea* has purple pseudostems. When dried *H. galpinii* leaves turn red, and in *H. obtusa* var. *obtusa* the dried foliage is silvery grey. *H. filiformis* at times produces whitish flowers.

3 CONCLUSIONS

On the basis of my findings I have recognized the following 11 species and 7 varieties of *Hypoxis* present on the Witwatersrand:

H. rigidula Bak.
- (a) var. *rigidula*
- (b) var. *pilosissima* Bak.
- (c) var. *hemerocallidea* (Fisch. & Mey.) Heid., *comb. et stat. nov.**

H. acuminata Bak.
H. filiformis Bak.
H. obtusa Burch.
- (a) var. *obtusa*
- (b) var. *nitida* (Verdoorn) Heid., *comb. et stat. nov.**

H. neliana Schinz
H. latifolia Hook. f.
H. galpinii Bak.
H. multiceps Buch. ex Bak.
H. interjecta Nel
H. rooperi Moore
H. argentea Harv. ex Bak.
- (a) var. *argentea*
- (b) var. *sericea* Bak.

A key and the descriptions of the species are to be published at a later date.

* This *comb. et stat. nov.* will be formally published elsewhere.

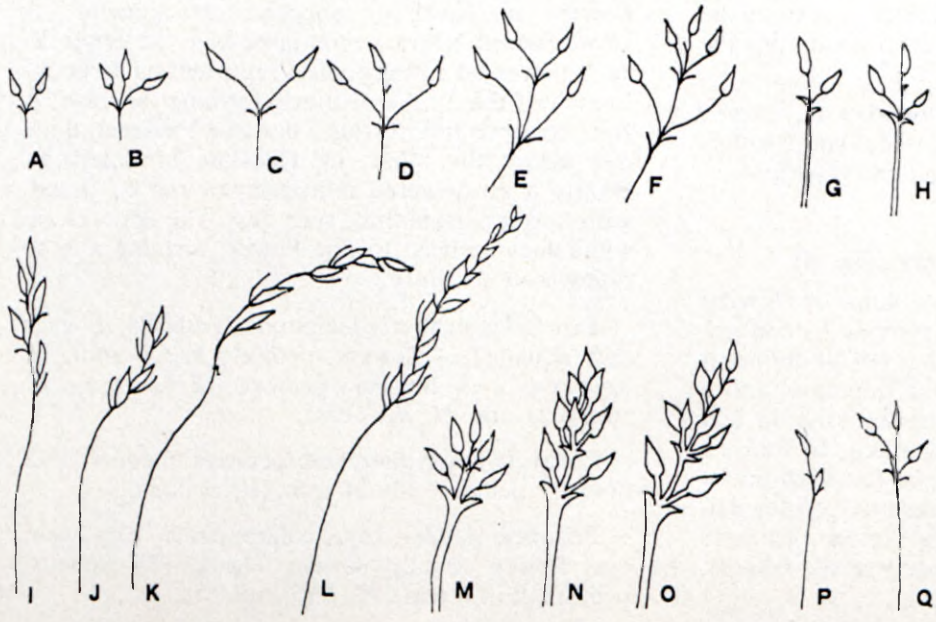

FIG. 4.—Inflorescences (× 1/4). A, B, *H. multiceps* and *H. interjecta;* C, D, E, F, *H. argentea* (C is a Y-shaped inflorescence); G, H, *H. neliana;* I, *H. galpinii;* J, *H. acuminata;* K, *H. rigidula* var. *rigidula;* L, *H. rigidula* var. *pilosissima* and var. *'hemerocallidea';* M, N, O, *H. obtusa* and *H. rooperi;* P, Q, *H. filiformis.* Ancipitous peduncles — single line; flattened peduncles — double line.

REFERENCES

BAKER, J. G., 1878. A synopsis of the Hypoxidaceae. *J. Linn. Soc., Bot.* 17: 93–126.

HUMMEL, K. & STAESCHE, K., 1962. Die Verbreitung der Haartypen in den natürlichen Verwandschaftsgruppen. In *Handbuch der Pflanzenanatomie*, 4,5. Berlin: Gebr. Bornträger.

METCALFE, C. R., 1960. *Anatomy of the Monocotyledons. 1: Gramineae.* London: Oxford University Press.

MÜLLER-DOBLIES, D., 1977. Über den geometrischen Zusammenhang der monochasialen Verzweigungen am Beispiel einiger Liliifloren. *Ber. dt. bot. Ges.* 90: 351–362.

NEL, G. C., 1914. Die afrikanischen Arten der Amaryllidaceae-Hypoxideae. *Bot. Jb.* 51: 301–340.

WALFORD, S. N., 1979. *Hypoxis rooperi* (Hypoxidaceae), eine bisher in Europa wenig bekannte Heilpflanze Afrikas. *Die Deutsche Apotheker* 11: 642.

WOOD, S. E., 1976. *A contribution to knowledge of the genus* Hypoxis *L. (Hypoxidaceae) in Natal, South Africa.* M.Sc. thesis, University of Natal.