***Hypoxis parvula*, Incandu Forest Reserve, Newcastle.** Photo: Yashica Singh.

HYPOXIS

Yellow stars of horticulture, folk remedies and conventional medicine.

by ***Yashica Singh,*** *Natal Herbarium, National Botanical Institute*

Hypoxis plants are usually easy to recognize by their bright yellow star-shaped flowers which have become known as yellow stars. For many years *Hypoxis* has been used by traditional healers to treat patients suffering from urinary-tract infections, infertility, impotency, anxiety and insanity. Recently considerable interest has been generated in the therapeutic properties of *Hypoxis* in treating prostatic hypertrophy and AIDS, and all of a sudden, knowledge about the plant is in great demand.

Classification

Hypoxis was previously placed in the Amaryllidaceae and Liliaceae, families, based on similarity in appearance to members within these families. However, we now know that it is quite different and is currently placed in a small family named after it, the Hypoxidaceae (star lily family). The Hypoxidaceae consists of 9 genera and about 152 species and occurs mainly in the southern hemisphere. About 60% of the 152 species belong to *Hypoxis*. Six of the genera (*Empodium*, *Hypoxis*, *Pauridia*, *Rhodohypoxis*, *Saniella* and *Spiloxene)* occur in southern Africa. All except *Hypoxis* are endemic to the region. *Pauridia*, *Rhodohypoxis*, *Saniella* and *Spiloxene* are restricted to South Africa. *Rhodohypoxis*, a genus with potential in the horticultural trade, is closely related to *Hypoxis* and may be distinguished from it by its white, pink or red flowers.

Distribution

Hypoxis occurs throughout most of the warm temperate and tropical zones of the world. It is absent from Europe, northern and central Asia, north Africa, extra-tropical South America and Canada. Thus far, no species is known to extend its distribution from one continent to another. In Africa, the genus is widespread south of the Sahara. The largest number of taxa (50) is found in southern Africa, where species are spread throughout the region, except in Botswana and the arid karroid regions of the Northern Cape and southern Namibia. All southern African taxa are represented in South Africa and grow mainly in the summer rainfall area. Seven taxa, (*Hypoxis angustifolia*, *H. argentea*, *H. floccosa*, *H. longifolia*, *H. setosa*, *H. stellipilis* and *H. villosa*) extend their range into the Western Cape. The centre of diversity for *Hypoxis* appears to be KwaZulu-Natal and the Eastern Cape. Each province has about 30 species.

Habitat

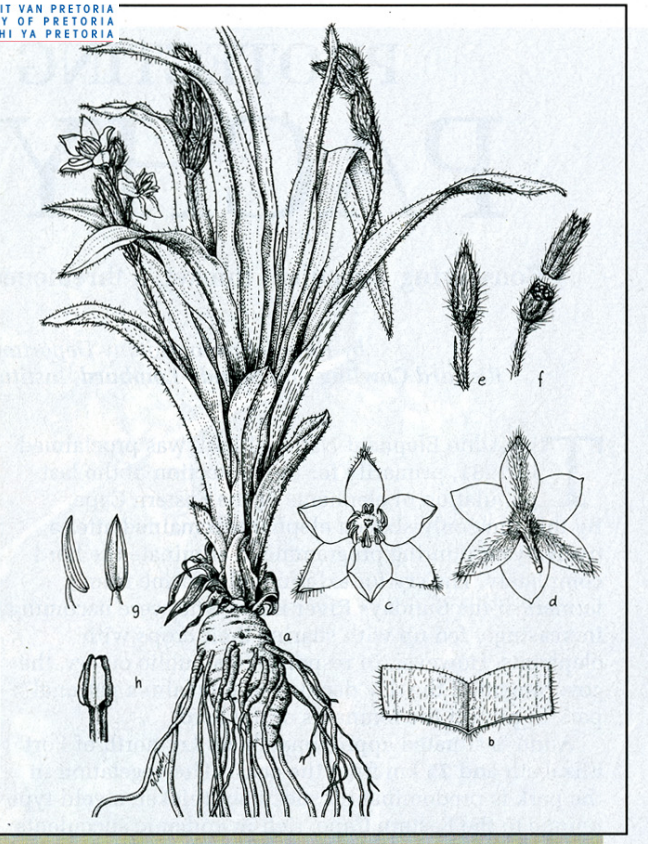
Hypoxis is a typical component of open grasslands. A few species are able to tolerate shaded conditions

THE MORPHOLOGY OF *HYPOXIS* using *H. hemerocallidea* as an example

Hypoxis plants are perennial geophytic herbs that are able to survive unfavourable conditions in the form of an underground vertical rootstock which is called a corm **(a)**. During favourable conditions (spring and summer) roots, leaves and flowering stems are produced from the rootstock. Corms are fleshy, mucilaginous and mostly single. In some species a corm may develop lateral branches and each branch in turn bears an aerial shoot thus creating a clump effect above the ground. Branching in corms may also arise when the apical point of a corm is damaged. Internally, corms are white, yellowish green, bright yellow or orange and the colour blackens with oxidation.

Leaves arise directly from the apex of the corm and are generally arranged one above the other in three defined vertical rows that radiate outwards from the centre of the plant. Leaf bases in some species are enclosed in a sheath which creates a column effect, known as a pseudostem or false stem. Leaves range from linear to broadly lanceolate, are erect or prostrate and are usually hairy **(b)**; except in a few species where hairs are lacking.
In some species younger leaves are markedly hairy which implies that at maturity hairs are deciduous while in other taxa, hairs are persistent in mature leaves.

Flowering stems are contemporary with leaves, axillary, hairy and are usually unbranched. The number of flowers per inflorescence varies from two to twelve. In a cluster, flowers may be opposite, alternate or in a whorl of three. Flowering stems may be broadly classified into two types: those with more than four flowers and those with less than four flowers. Each flower is borne on a short pedicel and is supported by a narrow hairy bract. Flowers are symmetrical, with usually six free tepals - three inner and three outer **(c)**. In open flowers, tepals are yellow or occasionally white on the upper surface and, green and hairy on the lower surface. Outer tepals are narrower and have a higher degree of greenness and hairiness on the lower surface than the inner tepals **(d)**. Six free stamens **(g)** are inserted at the base of the tepals. Generally, the style is short and thick, equal to or shorter



that the robust stigma **(h)**. In contrast, *H. parvula* and *H. membranacea* are characterized by a long narrow style which is two or more times the length of the minute stigma. Both species have been noted to hybridize naturally with members of *Rhodohypoxis*.

The fruit in *Hypoxis* is referred to as a pyxis (a capsule in which the apical section splits off as a lid at maturity). In *Hypoxis*, the apical section is formed by a crown of persistent tepals **(e)** which drops off at dehiscence **(f)**. Seeds are subglobose, hard, black, glossy and smooth, or dull and papillate.

These intergeneric hybrids may well be worthy of cultivation as pot plants since many cultivars of *Rhodohypoxis* are already popular in Europe as pot plants.

Medicinal and other uses

For centuries *Hypoxis* species have been utilized as muthi by the different tribes in southern Africa. Roots or corms of *Hypoxis*, for instance are used by Zulu traditional healers in their treatment of intestinal parasites, infertility, urinary infections, heart weakness, cough, nausea, vomiting, palpitations and nervous disorders. An infusion of the tuber of *H. colchicifolia* (earlier name *H. latifolia*) is taken as an emetic against fearful dreams which is indicative of heart weakness. The Sotho use *Hypoxis* as a charm against thunder, lightning and storms. Leaves of *H. rigidula* and *H. hemerocallidea* are used to make rope. Local people in the Escourt area make a black polish from corms of *H. obtusa* which they apply to the floors of their huts (according to Fred Smith of Bushmansriver Gifts). In times of famine, corms of some species of *Hypoxis* are boiled or roasted for food by the Sotho and Xhosa people.

Sterols and sterolins from corms of *Hypoxis* boost the immunity of patients suffering from various ailments. One such sterol, hypoxoside is readily converted to rooperol, a biologically active compound that inhibits the proliferation of certain cancer cells and HIV-1. Around 1970, a drug based on B-Sitosterol-D-Glucoside, isolated from *Hypoxis* corms, proved to be effective in the treatment of prostate hypertrophy and became available in West Germany under a registered trade name. In 1997, the South African public was introduced, through the media (including the World Wide Web) to a miracle drug called 'Moducare'. This immunity booster is claimed to help patients suffering from prostatic hypertrophy, AIDS, TB, ME, arthritis and psoriasis. 'Moducare', which is advertised as the 'African Potato Plant' extract or tablet, is available from health shops and pharmacies without prescription. The drug was originally based on phytosterol extracts from corms of *H. hemerocallidea*. It is important to note that contrary to continual reports and advertising, sterols from *H. hemerocallidea* are no longer used in the manufacture of 'Moducare' capsules. Instead isolates from various other plant sources such as soya beans are being used in the production of this drug.

Acknowledgements
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found in forest margins. *Hypoxis filiformis* and *H. acuminata* are examples of species that prefer moist depressions in vleis. Other species such as *H. parvula* and *H. membranacea* inhabit damp grassy banks and crevices in boulders. *Hypoxis* corms have a high tolerance to fire, in fact fire promotes the growth of new leaves and flowering in the genus. Plants of *H. hemerocallidea* (previously called *H. rooperi*) were observed to produce leaves and flowers shortly after a burn, irrespective of the month of burning (March to August). During the regular flowering period (September to January), those plants that had flowered earlier in the year were observed to flower again. The soil-stored seeds of *Hypoxis* also have fire-stimulated germination and it appears that seed dormancy is broken by smoke. Exactly which fire cue (physical or chemical) responsible for seed germination in *Hypoxis* is still unknown.

Above. ***Rhodohypoxis baurii* var. *baurii*, Ngele Nature Reserve, near Kokstad.** Photo: Rosemary Williams. Below. ***Rhodohypoxis baurii* var. *platypetala*.** Drawing by Jill Condy.

Etymology

Linnaeus, father of biological nomenclature, established the generic name *Hypoxis* in 1759. He coined the epithet *Hypoxis* from the Greek words *hypo* (below) and *oxy* (sharp) in reference to the ovary or fruit which is pointed at the base. In southern Africa, various vernacular names include star flower, star grass, gifbol, inkbol and sterretjie (Afrikaans); ilabatheka, inKomfe, inkomfe-enkula (Zulu); moli (Sesotho) and tshuka (Tswana).

In early 1997, media reports on the miracle drug based on *Hypoxis hemerocallidea*, introduced the common name 'African potato' (Afrika-patat in Afrikaans) for the plant. The coined name 'African potato' cannot be traced directly to any common name used in the past. Researchers involved in testing the effect of the drug in improving the immune system in cancer and AIDS patients were unable to afford the author any explanation for the origin of the name 'African potato'. Is the designation an imagination of journalists? It is possible that the word 'African' relates to the variety of uses of *Hypoxis* in African traditional medicine or to the fact that the plant occurs in Africa. *Solenostemon rotundifolius* (Lamiaceae) is aptly referred to as the 'Zulu round potato' or hausa potato as it is used as a substitute for potatoes in West Africa. Use of the term 'potato' for the *Hypoxis* corms is inappropriate as it alludes to a substantial staple food such as *Solanum tuberosum* (Solanaceae) or *Solenostemon rotundifolius*. In contrast, *Hypoxis* corms have an unpleasant bitter taste and it is unlikely that any member of the genus would ever become a food crop. Nevertheless, the designation 'African potato' has no doubt become a favourite among the South African public and despite its inappropriateness it will continue to be used.

Pollination

Flowers of *Hypoxis* are fairly short-lived. They open for approximately five to nine hours for one day only. Flowers open sequentially from the base to the apex of the inflorescence.

In *H. hemerocallidea*, mostly one to three flowers open per day with an interval of about an hour between opening which seemingly encourages cross pollination. There is an interval of a week between the development of new inflorescences on the same plant in this species. In *H. obtusa*, up to eight flowers per inflorescence open on the same day and flowers open simultaneously on several inflorescences in a single plant. This flowering strategy gives rise to fields of yellow in the Escourt and Weenen districts in summer. Solitary and honey bees are a common sight in flowers of *Hypoxis* during the early hours of the day. It is not uncommon for a bee to spend much time in the larger flowers such as those of *H. hemerocallidea*, usually with head facing the inside of the flower, loading its pollen sacs. The yellow pollen grains are easily visible through the transparent pollen sacs of bees. In the smaller flowered species, such as *H. argentea* and *H. filiformis* bee visits are expeditious and often impossible to photograph.

Horticulture

Yellow stars are used as garden ornamentals because of their showy flowers and their tolerance of dry conditions. At present only a few species of *Hypoxis* are in cultivation. *H. hemerocallidea*, *H. colchicifolia* and *H. angustifolia* have thus far entered the nursery trade. For showiness of colour, *H. obtusa* would also be worth promoting as a garden plant. Once in cultivation, yellow stars are relatively simple to maintain. It is however, difficult to rapidly germinate *Hypoxis* seeds under standard nursery conditions. Untreated seeds remain dormant for about one year before germination. Corm division is a more rapid and guaranteed form of propagation. *Hypoxis parvula* (with white or yellow flowers) and *H. membranacea* (white-flowered) hybridize with *Rhodohypoxis* in nature.

RHODOHYPOXIS, BEAUTY IN ABUNDANCE

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See page 86 for color plates.

Over the grassy zigzagging slopes of the mystical Drakensberg Mountains in the interior of southern Africa, resides the inherent beauty and splendour of some 400 plant genera. Many of these have their centre of diversity in the Drakensberg. One such genus is *Rhodohypoxis*. In the spring and summer months, the rose-colored, dainty flowers of *Rhodohypoxis* appear en masse (Fig. 1), staining the grassy hills and rocky outcrops. This small yet distinctive group of hardy perennial herbs has also found its place among the pot and landscape ornamentals in Europe, the United Kingdom, the United States and Japan, as it is excellent for alpine gardens. The purpose of this account is to introduce this fascinating genus, to reveal the characters of wild species, and to highlight their decorative potential.

Rhodohypoxis belongs in the Hypoxidaceae or star-lily family and is a close ally to the genus *Hypoxis* (Fig. 2). Plants of *Rhodohypoxis* were placed in *Hypoxis* up until 1914, when Gert Nel recognised that these rose-colored flowering herbs were in fact different from their yellow star-flowered counterparts. Nel established the genus *Rhodohypoxis* to accommodate the '*Hypoxis*' plants with white, pink or red flowers. At that stage, he recognised two species, *R. baurii* and *R. rubella*. The prefix *Rhodo-* refers to the rose-colored flowers of the genus and *hypoxis* to the structural similarity shared with plants in that genus. *Rhodohypoxis* differs from *Hypoxis* by virtue of its white, pink or red flowers, the presence of a perianth-tube, and stamens hidden and lacking well-defined filaments (Nel, 1914). In addition to this, Hilliard and Burtt (1978) pointed out that in *Rhodohypoxis* the 3 inner perianth-segments flex inwards to meet at the throat of the flower. Figures 3a & b illustrate the structural distinction between flowers of these 2 genera. A generic description of *Hypoxis* is given in Veld & Flora (Singh, 1999).

Rhodohypoxis is a small genus of 6 species with a distribution centered in the Eastern Region of the Drakensberg (Fig. 4). *R. baurii* and *R. milloides* have a wider distribution as they also inhabit outlying ranges of the Drakensberg, including the Mawahqua, Insizwe, Insikeni, Currie, Ngeli and Tabankulu Mountains in the Eastern Region of South Africa. The most

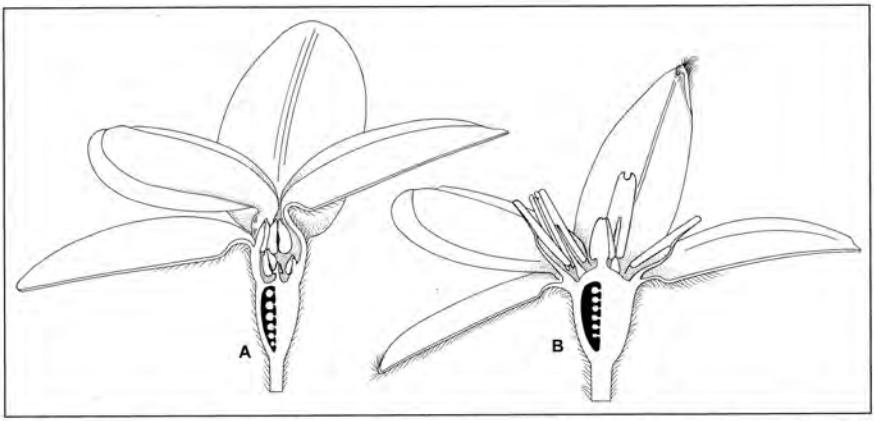


Fig. 3. Half flower drawings showing structural differences between A. *Rhodohypoxis baurii* var. *platypetala* and B. *Hypoxis setosa*

variable taxon, *R. baurii* var. *confecta*, is fairly widespread from the Eastern Cape Province through the corridor formed by the KwaZulu-Natal and Free State Provinces in South Africa, and Lesotho. Its distribution dwindles along the western border of Swaziland into South Africa's Northern Province. *R. thodiana* and *R. incompta* have a very narrow distribution restricted to the KwaZulu-Natal-Lesotho border at Giant's Castle and Sani Pass, respectively. These two KwaZulu-Natal Drakensberg endemics are considered to be near threatened and are protected in the uKhahlamba Drakensberg Park (Scott-Shaw, 1999).

On the Drakensberg itself, *Rhodohypoxis* plants grow in the grassy slopes and rock outcrops of the Little Berg and Main Escarpment. The vegetation belt of the Little Berg is subalpine, 1800-2800m, while that of the Main Escarpment is alpine, ca. 2800-3500m (Killick, 1990). The mountain is typified by black clay soils, cool to mild temperatures, fairly wet summers and relatively dry winters. Frost occurs almost daily in winter. Fire and wind also contribute to the ecological and floristic preservation of the mountain. Plants of *Rhodohypoxis*, like those of most monocots in the Drakensberg, are able to withstand frost and fire by means of an underground rootstock and seasonal growth pattern. In the Little Berg, *Rhodohypoxis* is a distinctive component in the predominantly short grasslands. The plants grow in peaty soil among the grasses and on rock surfaces, where they form carpets. These grasslands are intrinsically diverse, containing several species of forbs and grasses. On the Main Escarpment, *Rhodohypoxis* is restricted to bogs and sponges, where the soil is regularly moist to wet (Killick, 1990).

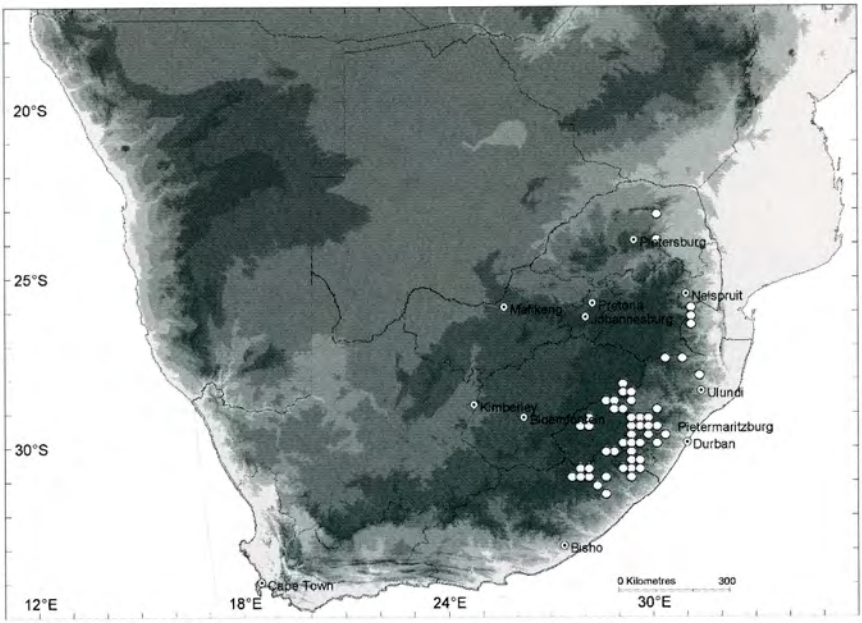
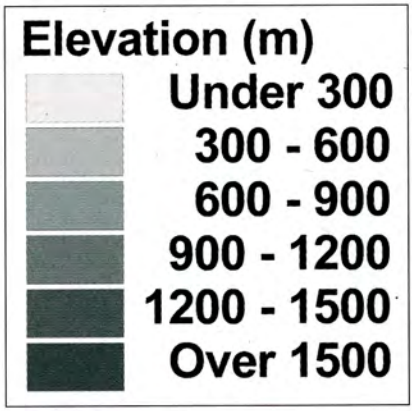


Fig. 4a. Distribution of *Rhodohypoxis*, centred in the Eastern Region of the Drakensberg.



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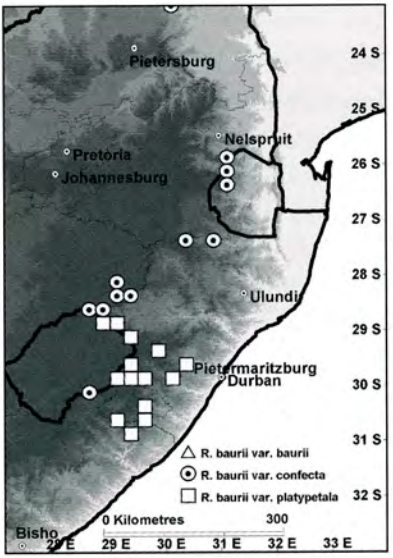

Fig. 4b. Distribution of the widespread *R. baurii* varieties extends to outlying ranges of the Drakensberg.

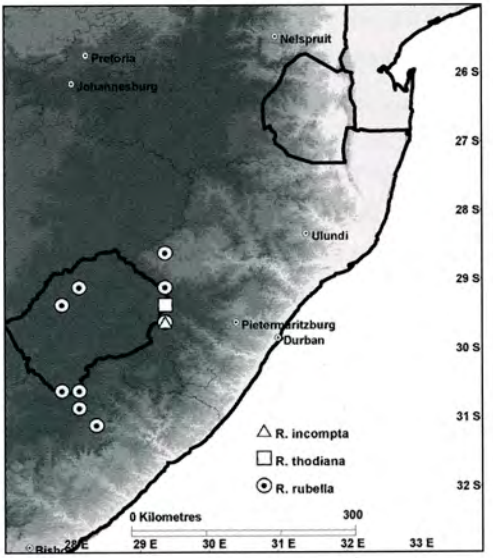

Fig. 4c. Distribution of the near threatened endemics *R. incompta* and *R. thodiana* and the more widespread *R. rubella*.

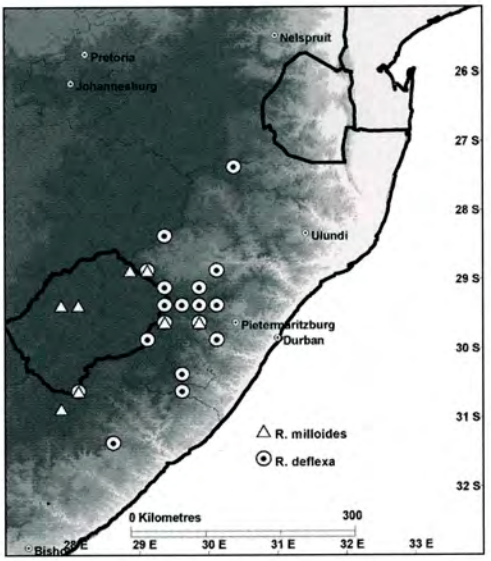

Fig. 4d. Distribution of *R. milloides*, extends to the outlying ranges of the Drakensberg, and *R. deflexa*, confined to high altitudes in Lesotho and surrounding Provinces in South Africa.

PLANT STRUCTURE

Plants of *Rhodohypoxis* are small perennial geophytes, to 15cm in height, that die back in winter. The underground vertical rootstocks or rhizomes are joined to one another by stolons. Five to ten leaves arise from the apex of each small rhizome. These triangular, linear-lanceolate to filiform leaves are bright or dull green and are usually hairy to a varying degree among taxa and age of the leaves. The number of inflorescences per plant is proportional to the number of leaves with up to ten per plant. The long and erect peduncles bear a single flower, but may be forked to support two flowers. Flowers consist of six perianth-segments in two series; the three inner ones being slightly narrower than the outer ones. The perianth-segments are either white, pink or red, or white and pink variegated. They fuse distally to form a short perigone tube. Just above the tube, the inner segments flex inwards to converge, closing the throat of the flower. Above the throat, the perianth-segments spread outwards and are persistent following fertilization. Six stamens arranged in two series arise from the perigone tube; the outer set lies above the inner. Anthers are hidden below the perianth-segments and are sessile to subsessile. The trilocular ovary is beaked or beakless and contains 4-6 ovules arranged axially in each locule. A very short style bears a 3-lobed stigma. The fruit is a thin, papery capsule with circumcissile dehiscence as in *Hypoxis*. In some taxa, the fruit breaks up irregularly below the apex. Seeds are round to oval, black, shiny and brittle. Plants flower between October and February.

Notes on species based on detailed site studies done by Hilliard and Burtt (1978):

Rhodohypoxis baurii var. *baurii* (Fig. 5). Widespread from Eastern Cape through to Northern Province, concentrated in KwaZulu-Natal. Leaves narrow, suberect and dull green. Flowers characteristically deep red, rarely white. Habitat moist, cliff faces and rocks. Hybridises with *Hypoxis parvula* var. *parvula*.

Rhodohypoxis baurii var. *confecta*. Widespread from the Eastern Cape to Northern Province. Leaves erect and bright green. Flowers white or pink with some reds; some flowers opening white, changing to pink and then to red with age. Habitat moist, grassy slopes, rock outcrops or plateau summits. Hybridises with *R. deflexa, R. thodiana* and *Hypoxis parvula* var. *parvula*.

Rhodohypoxis baurii var. *platypetala* (Fig. 6). Concentrated in KwaZulu-Natal. Leaves broad and flat, erect or spreading, grey green. Flowers mainly white, occasionally pale pink. Habitat dry, stony soil on rock sheets, rocky grassland. Hybridises with *R. milloides* and *Hypoxis parvula* var. *albiflora*.

Rhodohypoxis milloides. Distributed from the Eastern Cape to the northern border of KwaZulu-Natal. Leaves linear to lanceolate, subglabrous and bright green . Flowers crimson, rarely pink or white. Habitat marsh. Hybridises with *R. baurii* and *Hypoxis parvula* var. *albiflora.*

Rhodohypoxis deflexa. Occurs in Eastern Cape, KwaZulu-Natal and Lesotho. Leaves linear-lanceolate. Flowers bright reddish-pink or pale pink, very small. Habitat marsh.

Rhodohypoxis thodiana. Localised in Giant's Castle area at the KwaZulu-Natal-Lesotho border. Leaves lanceolate and flat. Flowers pale pink, scented. Habitat moist, grassy slopes. Hybridises with *R. rubella.*

Rhodohypoxis rubella. Occurs in Eastern Cape, KwaZulu-Natal and Lesotho. Miniature plants to 5cm. Leaves triangular-filiform and subglabrous. Flowers bright pink, rarely pale pink to white, very small. Habitat moist, stony soil on rock sheets, seasonal pools. Hybridises with *R. thodiana*

Rhodohypoxis incompta. Localised at Sani Pass area at the KwaZulu-Natal-Lesotho border. Leaves triangular-filiform, subglabrous. Flowers pink. Habitat, wet, gravelly soil on rocks, edges of grass or sedge tussocks on sandstone rock sheets.

GROWING *RHODOHYPOXIS*

At least 12 varieties of *Rhodohypoxis* are available in the United Kingdom, Europe, the United States and Japan. Species in the trade include *R. baurii, R. milloides, R. deflexa* and *R. thodiana*, with *R. baurii* the most common. Varieties of *Rhodohypoxis* sell for $2.99–$6.75 in the States and £1.50 to £4.00 in the UK per 4 inch pot. As white, pink or red flower color (dependent on the age of the flower) in *R. baurii* var. *confecta* is displayed on a single plant (Fig. 7), this offers a brilliant mix in one pot. The perianth-segments are persistent following the reproductive phase of the flower and thus provides the desirable advantage of a long flowering period. Cultivated hybrids of *Rhodohypoxis baurii* and *Hypoxis parvula*, named X *Rhodoxis hybrida* B. Mathew (Mathew, 1998) are popular pot plants in the United Kingdom (B.L. Burtt, Royal Botanic Garden, Edinburgh , pers. com. 1999).

It is rather difficult to grow *Rhodohypoxis* in warm and humid conditions like those experienced in the coastal region of South Africa. Plants are adapted to seasonal rainfall and, once established, require no watering during the dry season. They are also frost and snow hardy and thus are well suited to northern hemisphere gardens. Vegetative propagation is easily achieved by division of the underground stolons that hold the plants

together in a clump. Rhizomes are small and require shallow planting in well-drained loam soil. Seed germination is slow, requiring 30–60 days.

Rhodohypoxis plants are suitable as pot plants as well as for bedding in cool climates. Flowers of *Rhodohypoxis* provide good color in the landscape, especially beautiful when grown *en masse.*

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RHODOHYPOXIS (SINGH; PP. 162–168)

Fig. 1. *Rhodohypoxis baurii* var. *confecta* forming a colorful cluster on rocky precipices at Sentinel Peak, a scenic part of the Free State Drakensberg.

Fig. 2. *Hypoxis costata*, yellow flowers with perianth-segments free and stamens visible.

Fig. 5. *Rhodohypoxis baurii* var. *baurii*; deep red flowers dot the slopes of Jonkershoek, Eastern Cape Drakensberg.

Fig. 6. White flowers of *R. baurii* var. *platypetala* in KwaZulu-Natal Midlands.

Fig. 7. *Rhodohypoxis baurii* var. *confecta*, red, pink and white flowers on a single plant.

All photos by Y. Singh

Getting to Grips with *Hypoxis*

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HYPOXIS. *Cor.* 6-partita. *Stam.* breviora. *Germen* inferum (*corolla 6 parts, stamens short, ovary inferior*).

This unimposing description of a new genus by Carl Linnaeus in 1759 in *Species Plantarum* included three species and marked the beginning of what is now a rather complex group of some 90 species. *Hypoxis* is part of a small monocot family, the Hypoxidaceae (Star-flower family) and is distributed in the warmer regions of all continents except Europe. In sub-Saharan Africa, there are about 60 *Hypoxis* species, with 35 of these in southern Africa (namely South Africa, Lesotho, Namibia, Botswana and Swaziland). The greatest species richness and endemism occur in the eastern region of South Africa, that is to say in the KwaZulu-Natal and Eastern Cape Provinces. The occurrence of *Hypoxis* extends from coast to alpine parts of southern Africa, mainly in grasslands. A few species prefer partial shady conditions in open woodlands or forest cliffs. It is very rare to step out into grasslands in the summer-rainfall region of South Africa during the growing season and not encounter some or other species of *Hypoxis*.

Hypoxis plants are fairly easy to recognise in the field. They are geophytic, erect herbs with leaves usually hairy; flowers star-shaped, yellow (white in a few species), with perianth-segments and anthers free. It is however difficult to distinguish between species in the genus and the reasons for the difficulties are explained below. It is easier to begin to identify a *Hypoxis* plant by placing it into a species group. Eight species groups are recognised for southern African *Hypoxis*. This article provides the morphological characters of each of the groups.

Why is it difficult to identify *Hypoxis* species?
Hypoxis species are not clearly defined due to a lack of distinctive morphological characters. Species are represented by sets of morphological characters that often overlap. Furthermore, the changing growth forms of plants during the growing season are not well recorded and depending on the stage of development, a plant may not match its description. For instance, in *H. multiceps* and *H. interjecta* leaves are hysteranthous (flowers appear before leaves). The flower stalks appear similar in both species and pose problems for identification. With the onset of leaves, the appearance of the plants is altered and at this stage separation of species is possible on differences in leaf characters.

The phenomena of hybridisation, polyploidy and apomixis cause frequent morphological variation in *Hypoxis* and it is this interspecific variation that adds to the difficulty of identifying species. **Hybridisation** between some species in *Hypoxis* causes practical taxonomic problems, because morphological characters in the hybrids become obscure, and characters in these plants cannot be matched with those of either parent. For example, it is impossible to recognise natural hybrids between the distinct species *H. rigidula* and *H. obtusa* without an understanding of the populations of these plants in the wild.

Hypoxis has a diploid chromosome count of 2n=14 and a base chromosome number of x=7. **Polyploidy** causes the chromosome set to replicate one to several times and this is responsible for variation in chromosome numbers within a species. In *Hypoxis*, polyploidy has produced chromosome counts of 2n= 28, 42, 56, 70 within various species. These plants are referred to as tetraploids, hexaploids, octoploids and decaploids (divided by x=7) respectively. In diploid plants the taxa are morphologically distinct. At higher ploidy levels, morphological differences between taxa become unclear and distinct taxa cannot be recognised, thereby creating problems for identification. Polyploids often possess attributes that allow them to adapt to new ecological niches. The range of variation at different ploidy levels is not well understood in *Hypoxis*.

Apoximis is the production of viable seeds without the transfer of pollen i.e. 'seeds without sex'. The embryo is formed by maternal tissue only and the offspring is genetically identical to its maternal parent. Since pollen viability is high in *Hypoxis*, the occurrence of apomixis in the genus cannot be correlated with a reduction in pollen viability (Zimudzi, 1994). This makes *Hypoxis* a facultative apomict, i.e. apomictic and also sexual. Zimudzi (1994) determined that all apomictic species of *Hypoxis* are polyploids. It still needs to be established whether all apomictic *Hypoxis* originate from hybridisation. The varying morphotypes in *Hypoxis*

H. argentea
Scan of herbarium sheet

GROUP 6

Plants solitary

Leaves few, erect, linear to linear-lanceolate, outer ones curved, moderately firm in texture, usually < 6mm (-10mm) wide.

Flowers yellow, stigma pyramidal.

H. argentea
H. parvifolia
H. kraussiana
H. flanaganii
H. uniflorata
H. obconica
H. gerrardii
H. dinteri
H. patula
H. neliana
H. floccosa

H. parvula

GROUP 7

Plants solitary or in clumps

Leaves few to many, erect to semi-erect, thin, almost membranous in texture, narrow or wide, up to 20mm wide.

Flowers yellow or white, stigma pyramidal or spherical.

H. angustifolia
H. membranacea
H. limicola
H. parvula

H. filiformis

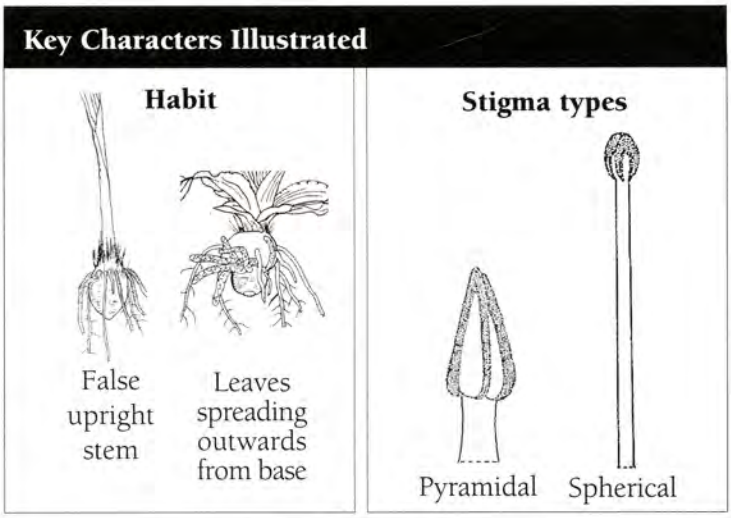
GROUP 8

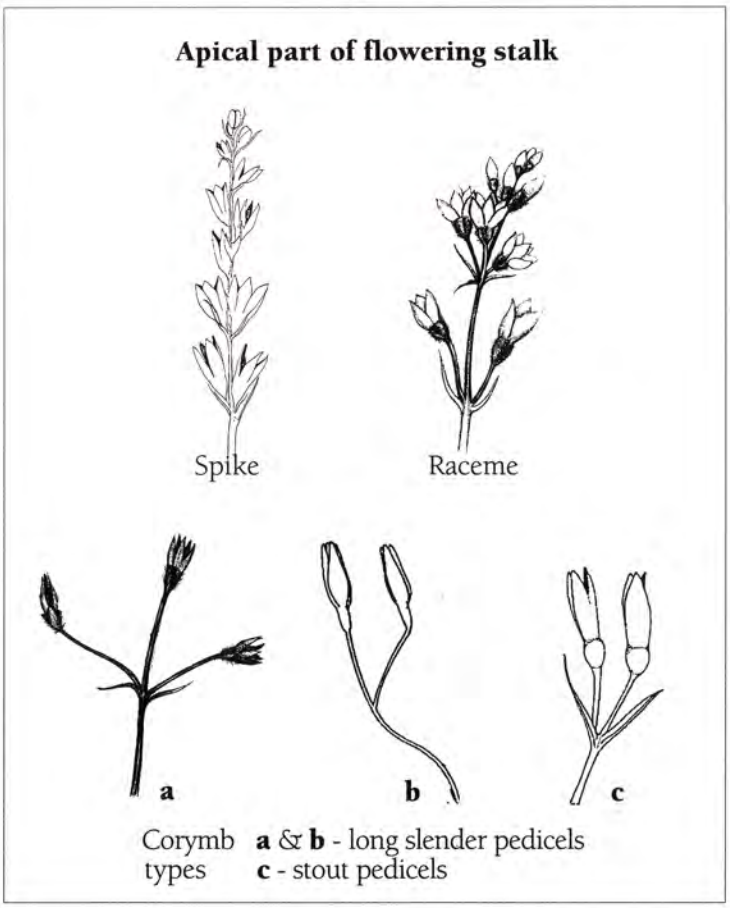
Plants solitary

Leaves rigid, thread-like, <3mm wide, margins curving inwards.

Flowers yellow, stigma pyramidal.

H. filiformis
H. tetramera





Illustrations

Growth form line illustrations are by Angela Beaumont. The illustration of the raceme was extracted from Nordal *et al* (1985); those of corymb types a & b and stigma types are from Wood (1976).

Further reading

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Species groups illustrated, described further and members listed

H. colchicifolia

GROUP 1a

Leaves widening above false stem into the shape of a funnel, broadly lanceolate, stiff in texture, strongly ribbed, broad, 20-50mm wide.

Leaf lamina hairless to sparsely hairy.

H. colchicifolia
H. galpinii

H. rigidula

GROUP 1b

Leaves spreading outwards and recurving above false stem, linear, moderately firm in texture, only veins along margins prominent, narrow, <20mm wide.

Leaf lamina sparsely to densely hairy.

H. cordata
H. oblonga
H. rigidula

H. acuminate
Scan of herbarium sheet

GROUP 2

Leaves spread outwards and upwards loosely from base, false stem not obvious, erect to semi-erect, moderately firm in texture, narrow, 300-400mm long, <13mm wide.

Leaf lamina hairless to densely hairy.

H. acuminata
H. exaltata
H. ludwigii
H. longifolia

H. obtusa

GROUP 3

Leaves tightly stacked in 3 ranks, broad, usually >20mm wide.

Flowering stalk a raceme.

H. hemerocallidea
H. obtusa

early season

late season

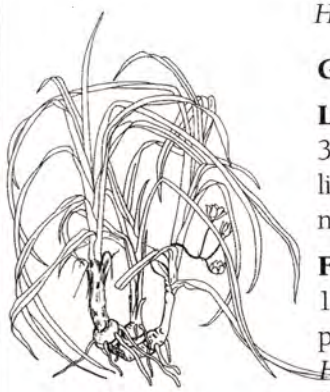
H. multiceps

GROUP 4

Leaves stiff, oblong-lanceolate, erect to semi-erect, broad, >25mm wide.

Flowering stalk thick and stiff, with 1-5 flowers on stout pedicels.

H. costata
H. interjecta
H. multiceps



H. setosa

GROUP 5a

Leaves loosely stacked in 2-3 ranks, moderately firm, linear to lanceolate, recurving, narrow, 8-20mm wide.

Flowering stalk pliable with 1-7 flowers on long slender pedicels.

H. setosa
H. sobolifera
H. villosa

H. stellipilis

GROUP 5b

Leaves lanceolate, tightly stacked in 3 ranks, dark green and hairless on upper surface, hairs forming felt-like white coating on lower surface; narrow, 10-20mm wide.

Flowering stalk long, pliable with 2-6 flowers on long slender pedicels, all pedicels arise at same point.

H. stellipilis

may be attributed to the occurrence of hybridisation, polyploidy and apomixis, and their interrelatedness drives the evolution of new entities, keeping the genus in a state of flux.

The 35 southern African species are classified into 8 broad groups based on morphological characters. A key to species groups using the readily observable characters of growth form, leaf texture, type of flowering stalk, number of flowers and stigma type is provided below. The key includes characters that may overlap between groups. It is therefore necessary to use the combination of characters to separate species groups. Diagnostic characters for each group appear in bold type. In addition, the growth form of a representative species is illustrated for each group and additional diagnostic characters emphasised alongside the illustration. Lastly, diagnostic characters used in the key to species groups are illustrated to explain the terminology used.

Species groups: summary of key features	
Plants solitary; **40-60cm** tall; leaves clasping at the base to form a **false upright stem**, stiff to moderately firm in texture, hairless to densely hairy, flowering stalk long, firm, with 6-20 flowers on short pedicels (**raceme or spike**); flowers yellow, **>20mm** in diameter when open.	**Group 1**
Plants solitary or clump forming; **30-40cm** tall; leaves erect, spreading outwards and upwards, not forming a false stem but **loosely spreading from base**, rigid to moderately firm in texture, hairless to densely hairy; flowering stalk long, pliable, with 2-4 flowers on long slender pedicels (**corymb**); flowers yellow, **>20mm** in diameter when open.	**Group 2**
Plants solitary; **20-50cm** tall; leaves spreading outwards and upwards, not forming a false stem, **noticeably stacked tightly in 3 ranks**, stiff to moderately firm in texture, hairless to densely hairy; flowering stalk long, firm, with 8-15 flowers on short pedicels (**raceme**); flowers yellow, **>20mm** in diameter when open.	**Group 3**
Plants solitary or clump forming; **10-20cm** tall, **squat appearance**, leaves spreading outwards and upwards, not forming a false stem but **loosely spreading from base**, stiff to moderately firm in texture, hairless to densely hairy; flowering stalk long and thick with 2 (-4) flowers on **stout** pedicels (**corymb**); flowers yellow, **15-25mm** in diameter when open.	**Group 4**
Plants solitary or clump forming; **12-30cm** tall, leaves spreading outwards and upwards, not forming a false stem but **stacked either tightly or loosely in 2-3 ranks**, moderately firm in texture, sparsely to densely hairy; flowering stalk long and slender with 2-7 flowers on long and slender pedicels (**corymb**); flowers yellow, **15-25mm** in diameter when open.	**Group 5**
Plants solitary; **usually <15cm** tall; leaves spreading outwards and upwards, neither forming false stem nor neatly stacked in ranks, erect, moderately firm in texture, sparsely to densely hairy; flowering stalk long and slender with 1-3 (-5) flowers on long and slender pedicels (**corymb**); flowers yellow, **<15mm** in diameter when open.	**Group 6**
Plants solitary or clump forming; **usually <15cm** tall; **soft appearance**, leaves spreading outwards and upwards, neither forming false stem nor neatly stacked in ranks, erect to semi-erect, **membranous** in texture, sparsely hairy; flowering stalk long and slender with 1-3 flowers on long and slender pedicels (**corymb**); flowers yellow or white, **<15mm** in diameter when open.	**Group 7**
Plants solitary; usually **<15cm** tall; leaves spreading outwards and upwards, not forming false stem, erect, **rigid in texture, thread-like**, very sparsely hairy; flowering stalk long and slender with 1-3 (-4) flowers on long and slender pedicels (**corymb**); flowers yellow, **<15mm** in diameter when open.	**Group 8**