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Photosynthetic adaptation of two semi-arid species *Gethyllis* (Kukumakranka) to drought-and-shade stress

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Abstract:
Gethyllis multifolia and *Gethyllis villosa* are winter-growing, summer-blooming, deciduous and bulbous geophytes that grow naturally in the semi-arid 'Succulent Karoo Biome' of South Africa. *G. multifolia* is threatened in its natural habitat and resides in the 'Vulnerable' category of the 'Red Data List of Southern African Plants'. Previous investigations suggested that *G. multifolia* is more sensitive to drought stress than *G. villosa* and that both species adopted certain morphological changes in their leaves during shade stress. Current models indicate that this biome is being exposed to increasingly drier conditions and shading from encroaching indigenous plant species. In this study, the photosynthetic gas exchange responses of both species to drought and shade stresses were investigated and the 'Vulnerable' conservation status of *G. multifolia*. This investigation found that during drought stress *G. villosa* had a more enhanced photosynthetic performance than *G. multifolia* which appears not to be related to foliar adaptations such as specific leaf mass (SLM), but to the *G. villosa*'s leaves maintaining their stomatal conductance (G_S), photosynthetic light compensation (LCP) and photon yields. Furthermore, during shade stress *G. villosa* also had an improved photosynthetic performance by not altering its photosynthetic LCP during reduced light conditions. It can be concluded that *G. multifolia* has a lower capacity than *G. villosa* to adapt its photosynthetic apparatus to changing environments such as increasing drought and shaded conditions. This may be a contributing factor to the threatened conservation status of *G. multifolia*.

1. Introduction

The genus *Gethyllis* (family: Amaryllidaceae), indigenous to South Africa, consists of 37 currently accepted species and subspecies (Müller-Doblies, 1986). *Gethyllis* species have medicinal properties (Liltved, 1992; Elgorashi and Van Staden, 2003) and are characterized by four distinct growth phases. The plants that thrive under full sun conditions, are winter-growing, summer-blooming, deciduous and bulbous geophytes (Du Plessis and Delpierre, 1973; Manning et al., 2002). *Gethyllis multifolia* L. Bolus and *Gethyllis villosa* Thunb. grow naturally in the 'Succulent Karoo Biome' of South Africa, which is primarily characterized by low to high winter rainfall and extreme summer aridity. The rainfall varies between 20 and 290 mm per year and during summer the temperatures can be in excess of 40 °C.

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