

RESEARCH AND DEVELOPMENT IN CULTIVATION PRACTICES OF INDIGENOUS BIOLOGICAL RESOURCES

AFRICAN BIOTRADE FESTIVAL 2025

Johannesburg, Sandton Convention
Centre

INTRODUCTION

- Cultivation of medicinal plants – supply and demand
- Wild harvesting – unreliable, inconsistencies
- Variations in chemical composition – compromised quality
- Cultivation – conservation, preservation of IK, primary health care, commercialization opportunities
- Opportunity to manipulate the growth environment
- Response to environmental stress factors
- Secondary metabolite production – medicinal value
- Cultivation research – maximize yields, minimal adverse effect on quality, quality consistency
- Support and valorize the medicinal plant value chain



HARVESTING AND SOURCING

Semenya and Maroyi, 2019

- **Underground parts = 78%**
- Leaves = 10%
- Whole plant = 6%
- Bark = 4%
- Fruits and seeds = 2%

Source	Muthi Shops	Hawkers	Formal business
	%		
Famers	22.0	15.0	16.0
Wild harvesters	55.0	81.0	8.0
Cooperatives	23.0	4.0	8.0
Do not know	0	0	68.0

Ndout et al. 2019



Review

Medicinal plant harvesting, sustainability and cultivation in South Africa

A.S. van Wyk^{a,*}, G. Prinsloo^b^a Department of Environmental Sciences, University of South Africa, Florida campus, Florida 1710, South Africa^b Department of Agriculture and Animal Health, University of South Africa, Florida campus, Florida 1710, South Africa

ARTICLE INFO

Keywords:

Medicinal plant harvesting
Traditional health practitioners
Indigenous knowledge
Commercial harvesters
Sustainability
Medicinal plant cultivation

BIODIVERSITAS

Volume 20, Number 3, March 2019

Pages: 790–811

ABSTRACT

Concerns regarding the conservation of medicinal plant species are receiving much attention due to over-harvesting and exploitation. Medicinal plant harvesting is a global concern as plants are the source of the majority of medicines, either traditional or western, in the world. Millions of U.S. dollars of plant material are being exported annually from developing countries to developed countries. The challenge in developing countries is that, apart from the exports, the majority of people in those countries still use medicinal plant material for their basic healthcare needs. Biodiversity loss is therefore a significant challenge. This review focuses on South Africa as a developing country in which traditional medicines are highly valued, but also engages in exports of medicinal

ISSN: 1412-033X
E-ISSN: 2085-4722
DOI: 10.1037/biodiv/d200325

of medicinal
is discussed.
well as culti-
e challenges

Source, harvesting, conservation status, threats and management of indigenous plant used for respiratory infections and related symptoms in the Limpopo Province, South Africa

SEBUE SILAS SEMENYA^{1,2,*}, ALFRED MAROYI²¹ Technology Transfer Office, Research Administration and Development, University of Limpopo, Private Bag X1106, Sovenga 0727, South Africa. Tel.: +27-152683938, *email: sebuasemenya@gmail.com, sebuasemenya@ul.ac.za² Medicinal Plants and Economic Development (MPED) Research Centre, Department of Botany, University of Fort Hare, Private Bag X1314, Alice 5700, South Africa

Manuscript received: 26 August 2018. Revision accepted: 25 February 2019.

Abstract. Semenya SS, Maroyi A. 2019. Source, harvesting, conservation status, threats and management of indigenous plant used for respiratory infections and related symptoms in the Limpopo Province, South Africa. *Biodiversitas* 20: 790–811. This survey explored Bapedi traditional healer's (THs) practices pertinent to native plants used to treat respiratory infections (RIs) and related symptoms (RSs). Semi-structured questionnaires and participatory observations were used to gather information from 240 THs in the Limpopo Province, South Africa. 186 plants from 75 families were harvested by these THs, mainly from the communal lands (81.2%), throughout the year. Plant parts used for RIs and RSs remedies was destructively harvested in wilderness compared to homegardens. Most (n=174) species from which these parts are obtained appears on the South African National Red Data List of plants, with 88.5% having a list concern status. This included *Adansonia digitata*, *Boscia albitrunca*, *Catha edulis*, *Securidaca longepedunculata* and *Sclerocarya birrea* which are also protected under the National Forest Act of 1998 (Act no. 84 of 1998). A further, 8.6% (n=15) of Red Data Listed plants are of conservation concern, with various status namely near threatened (38.3%), declining (20%), data deficient (13.3%), critically endangered and vulnerable (3.3%, for each), as well as endangered (6.6%). There were both consensus and disjunction amongst THs and Red Data List regarding the status of plants in the wild. This study provides valuable data for the conservation of medicinal plants in Limpopo Province.



AUTHORS:

Motiki M. Mofokeng^{1,2}
Christian P. du Plooy¹
Hintsa T. Araya^{1,2}
Stephen O. Amoo^{1,3}
Salmina N. Mokhele^{1*}
Kgabo M. Pofu²
Phatu W. Mashela²

AFFILIATIONS:

¹ Agricultural Research Council – Vegetables, Industrial and Medicinal Plants (ARC-VIMP), Pretoria, South Africa² Green Biotechnologies Research Centre, University of Limpopo, Polokwane, South Africa³ Department of Botany and Plant Biotechnology, University of Johannesburg, Johannesburg, South Africa^{*} Current: School of Agricultural Sciences, University of Mpumalanga, Mbombela, South Africa

CORRESPONDENCE TO:



© Kamla-Raj 2019

PRINT: ISSN 0973-5070 ONLINE: ISSN 2456-6772

Ethno Med, 13(4): 226–236 (2019)

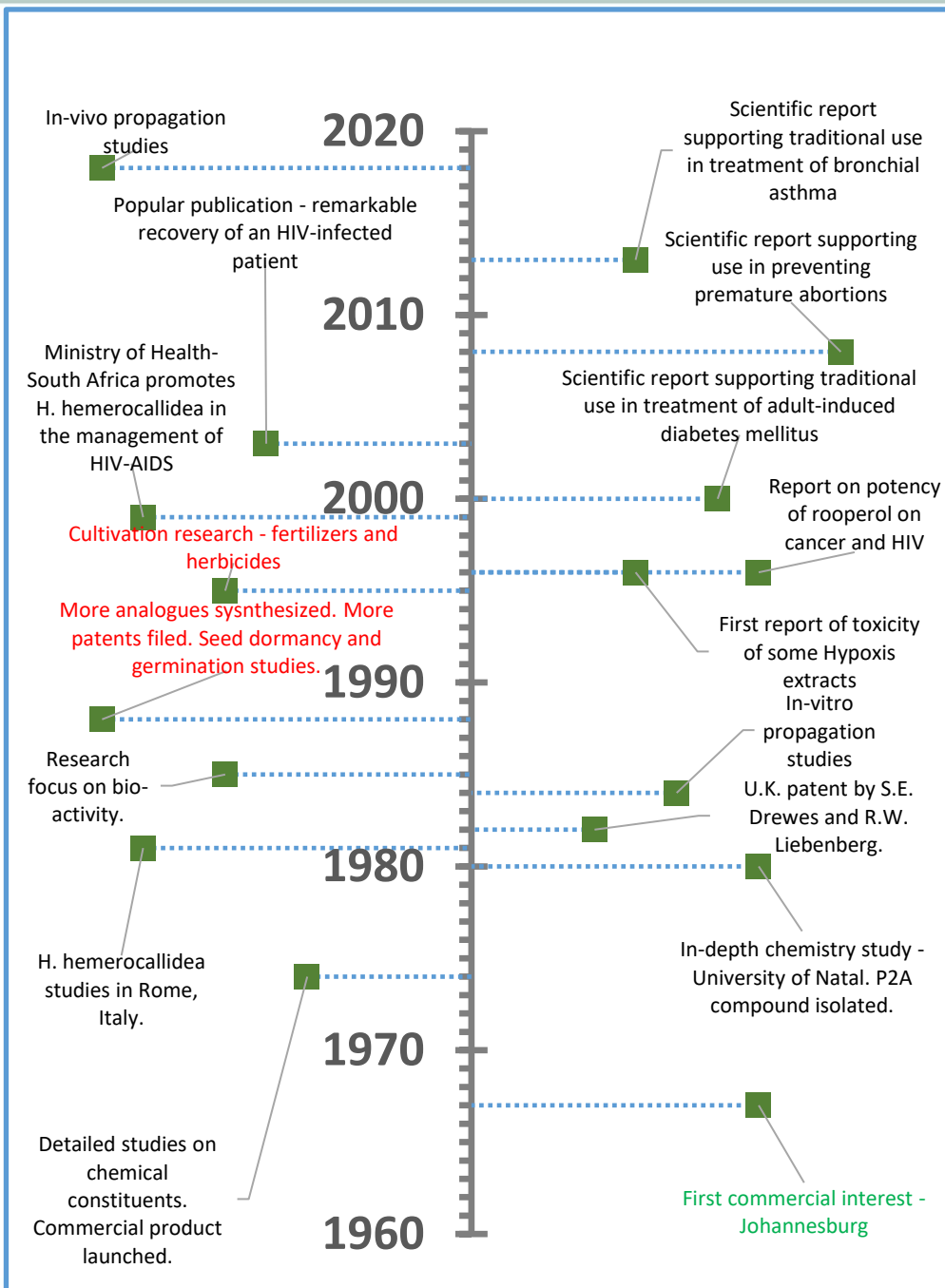
DOI: 10.31901/24566772.2019/13.04.579

Value Chain Analysis of Medicinal Plants in South Africa

P. Ndou^{1*}, B. Taruvinga¹, M.M. Mofokeng¹, F. Kruger¹, C.P. Du Plooy¹ and S.L. Venter¹¹ Agricultural Research Council – Roodeplaat, Vegetable and Ornamental Plants (ARC-VOP), Private Bag X293, Pretoria 0001, South Africa

KEYWORDS Commercial Production. Markets. Sustainability. Value-adding

ABSTRACT This paper explored the implications posed by the functioning of the medicinal plants value chain in South Africa on the economic viability and sustainability of smallholder enterprises. The paper identifies the main actors in the medicinal plants value chain as well as the opportunities and constraints associated with entry into the formal markets. The study made use of formal surveys with the medicinal plants market key informants and organisations. The formal value chain is very strict with very few actors engaged in partnership vertical integration characterised by strict quality control. The study advocates for strong support for medicinal plant producers by development agents, especially the smallholders together with assisting them to gain access into the high value chain. In addition, since processed or semi-processed products fetch higher prices, smallholder producers of medicinal plants need to be supported with agro-processing facilities to enable them to reap higher returns from their farming activities.



Diversity and Conservation through Cultivation of *Hypoxis* in Africa—A Case Study of *Hypoxis hemerocallidea*

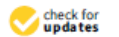
Motiki M. Mofokeng ^{1,2,*}, Hintsa T. Araya ^{1,2}, Stephen O. Amoo ², David Sehlola ², Christian P. du Plooy ², Michael W. Bairu ², Sonja Venter ² and Phatu W. Mashela ¹

¹ Green Biotechnologies Research Centre of Excellence, University of Limpopo, Private Bag X1106, Sovenga 0722, South Africa; arayah@arc.agric.za (H.T.A.); phatu.mashela@ul.ac.za (P.W.M.)

² Agricultural Research Council, Vegetable and Ornamental Plant Private Bag X293, Pretoria 0001, South Africa; amoos@arc.agric.za (S.O.A.); dsehlola@arc.agric.za (D.S.); iduplooy@arc.agric.za (C.P.d.P.); bairum@arc.agric.za (M.W.B.); sventer@arc.agric.za (S.V.)

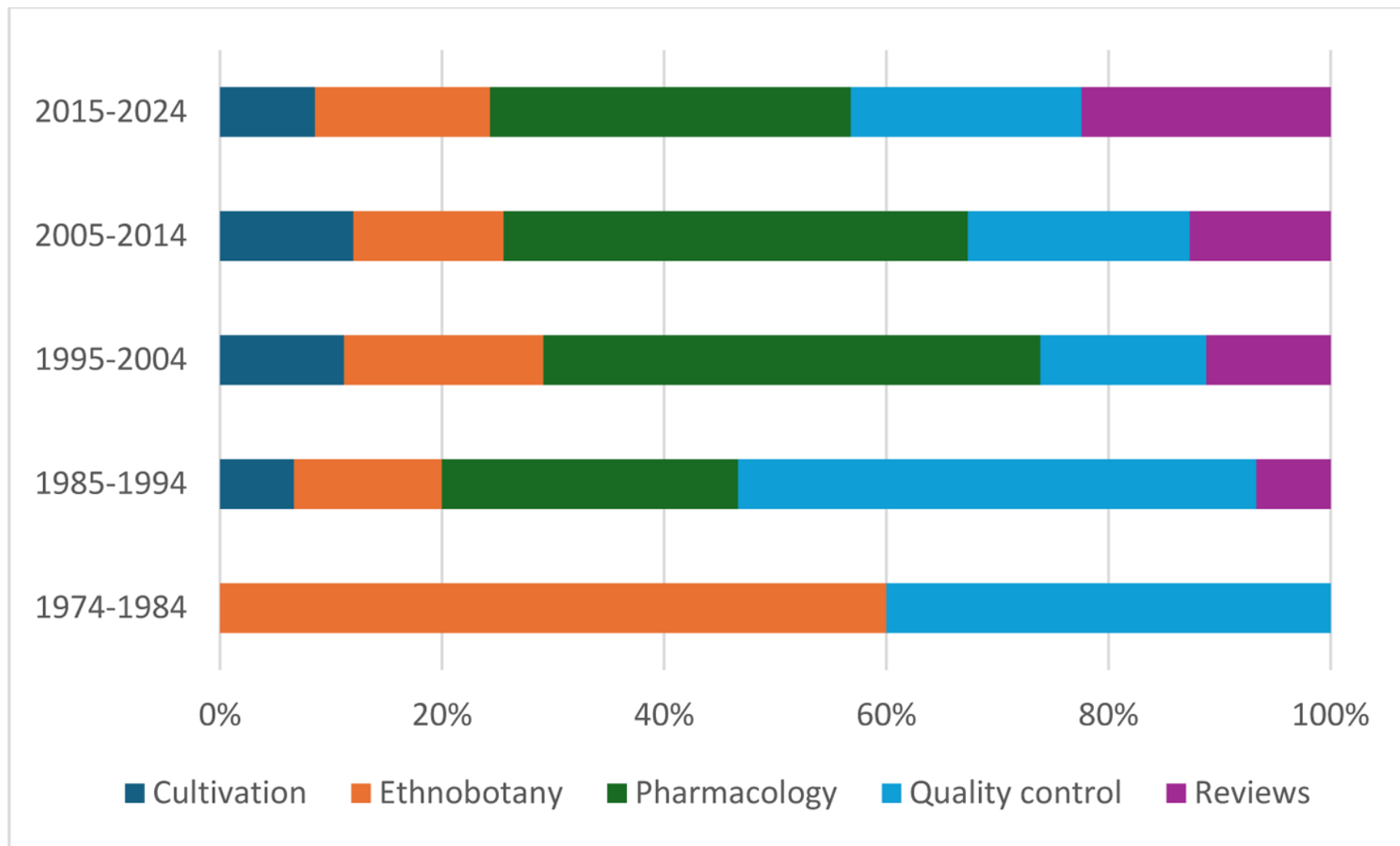
* Correspondence: MofokengM@arc.agric.za; Tel.: +27-(0)12-808-8000; Fax: +27-(0)12-808-0844

Received: 31 December 2019; Accepted: 20 March 2020; Published: 25 March 2020

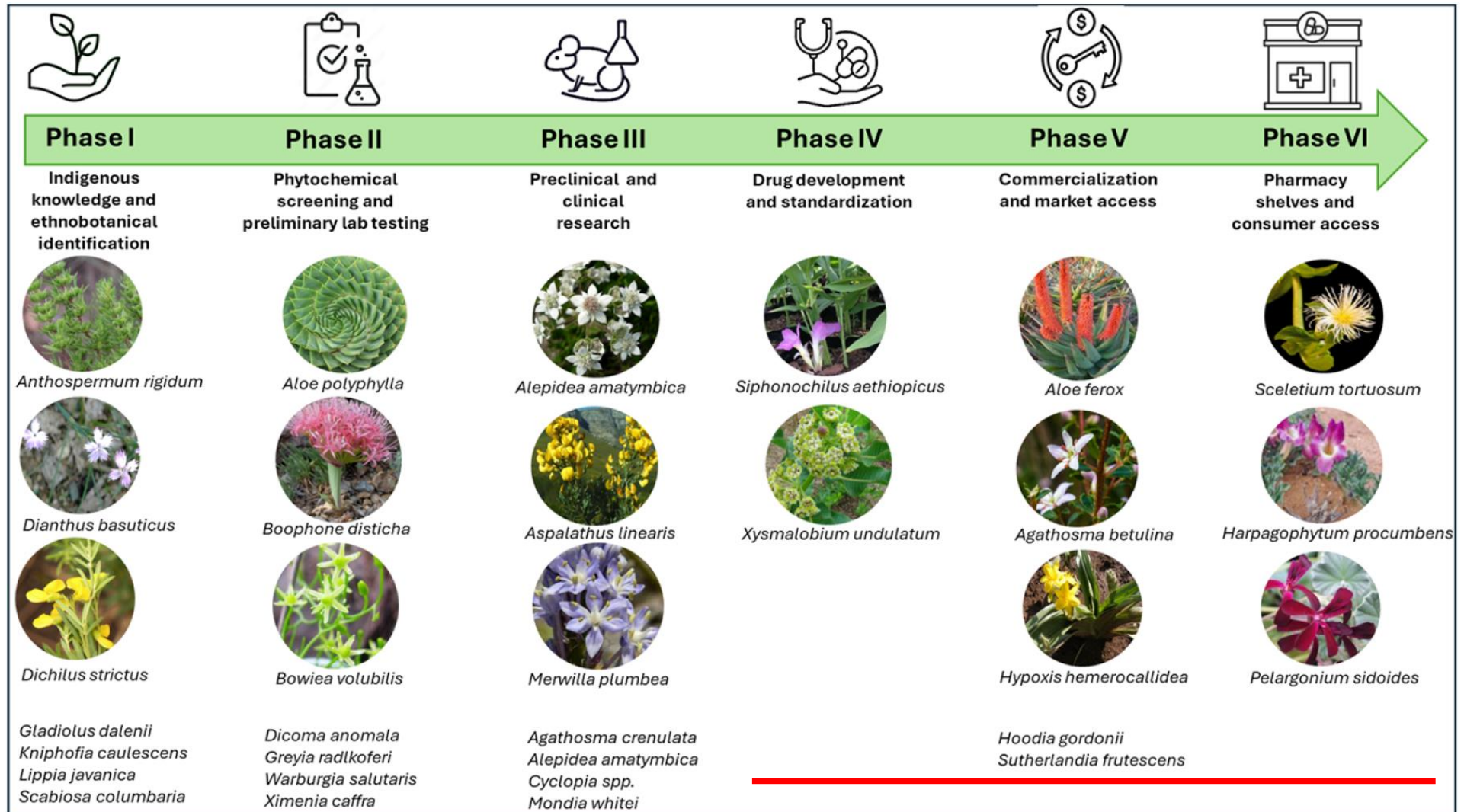


Abstract: Africa has the largest diversity of the genus *Hypoxis*, accounting for 61% of the current globally accepted taxa within the genus, including some endemic species. Using *Hypoxis hemerocallidea* as a case study, this review addresses the conservation concerns arising from the unsustainable, wild harvesting of a number of *Hypoxis* species. *Hypoxis hemerocallidea* is one of the wild-harvested, economically important, indigenous medicinal plants of southern Africa, with potential in natural product and drug development. There are several products made from the species, including capsules, tinctures, tonics and creams that are available in the market. The use of *H. hemerocallidea* as a “cure-all” medicine puts an important harvesting pressure on the species. Unsustainable harvesting causes a continuing decline of its populations and it is therefore of high priority for conservation, including a

RESEARCH FOCUS OVER TIME



RESEARCH, DEVELOPMENT AND INNOVATION



PROPAGATION STUDIES

Mofokeng, M., Prinsloo, G. and Kritzing, Q. (2012), *Seed Sci. & Technol.*, **40**, 123-128

Research Note

Germination response of four South African medicinal plants to a range of temperatures and treatments

M. MOFOKENG¹, G. PRINSLOO^{1*} AND Q. KRITZINGER²

¹ Agricultural Research Council – Roodeplaat, Vegetable and Ornamental Plant Institute (ARC-VOPI), P/Bag X293, Pretoria, 0001, South Africa (E-mail: GPrinsloo@arc.agric.za)

² Department of Plant Science, University of Pretoria, Pretoria, 0002, South Africa

(Accepted January 2012)

South African Journal of Botany 161 (2023) 531–541



ELSEVIER

Contents lists available at ScienceDirect

South African Journal of Botany

journal homepage: www.elsevier.com/locate/sajb



Seed germination and vegetative propagation of *Helichrysum odoratissimum*

Ivy Masefako Makena*, Babalwa Matsiliza-Mlathi, Riana Kleynhans

Tshwane University of Technology, Private Bag X680, Pretoria 0001, South Africa

ARTICLE INFO

Article History:
Received 5 July 2023
Revised 21 August 2023
Accepted 22 August 2023

ABSTRACT

Helichrysum odoratissimum is a popular indigenous herb of South Africa, well known for its aromaticity. It offers potential as a source of extracts for the development of cosmeceutical products as it has been reported to be a natural antibiotic, and has antifungal, antimicrobial, antioxidant and antiviral properties. In order to

Seed germination and vegetative production of *Greyia radlkoferi*, an indigenous tree of cosmeceutical importance

N. Nogemane^a and G. Prinsloo

Department of Agriculture and Animal Health, University of South Africa, Johannesburg, South Africa.

Abstract

Greyia radlkoferi is one of the important and recently studied cosmeceutical trees or shrubs indigenous to South Africa. It offers great potential as a source of

^aE-mail: nogemn@unisa.ac.za



Acta Hort. 1204. ISHS 2018. DOI 10.17660/ActaHortic.2018.1204.11

Proc. VII Int. Symp. on Seed Transplant and Stand Establishment of Hort. Crops

Eds.: P. Soundy et al.

Hypoxis hemerocallidea seed germination: a journey of investigation

T.J. Mtshweni¹, R. Kleynhans¹, B. Matsiliza-Mlathi¹ and F. Bierman²

¹Department of Horticulture, Tshwane University of Technology, Pretoria, South Africa; ²Department of Biomedical Sciences, Tshwane University of Technology, Pretoria, South Africa.

Abstract

Effective propagation systems are needed to ensure a sustainable supply of quality plant material for the commercialization of any natural product. The seeds of *Hypoxis hemerocallidea*, although abundant, are notoriously difficult to germinate. Several researchers have published on the subject and reported on dormancy and how



Acta Hort. 1358. ISHS 2023. DOI 10.17660/ActaHortic.2023.1358.23
XXXI IHC – Proc. Int. Symp. on Medicinal and Aromatic Plants: Domestication,
Breeding, Cultivation and New Perspectives
Eds.: C. Carlen et al.

171

Optimizing the cutting production of *Greyia radlkoferi*J. Malele^{a,*}, R. Kleynhans^a, G. Prinsloo^b, B. Matsiliza-Mlathi^a^a Tshwane University of Technology, Private Bag X680, Pretoria 0001, South Africa^b Department of Agriculture & Animal Health, University of South Africa, Private Bag X6, Florida 1710, South Africa

ARTICLE INFO

Article History:

Received 12 March 2021

Accepted 26 June 2021

Available online xxx

Edited by Dr O.O. Olarewaju

Keywords:

Greyia radlkoferi

Vegetative propagation

Cutting size

Cutting length

Season

ABSTRACT

Greyia radlkoferi leaf extracts has been proven to treat skin hyperpigmentation (De Canha et al., 2013). Propagation by seed is fairly easy, but seed germination of the bioactivity between plants, making it difficult to attain uniform and propagation using stem cuttings has been reported but need optimization. A design, with three replicates was used to investigate different seasons (winter, spring, cutting positions (basal, median and apical) and cutting lengths (5, 10, 15 and 20 cm) (survival percentage, rooting percentage, number of buds, number of leaves, n leaf length and root length). The best treatment combination was then applied to different ages of donor plants (1–4 year old) on cutting success. Data was analysed with significant differences were separated with a t-test at 5% level of significance. The basal position and median position produced significantly higher survival and roots, buds and leaves as compared to the apical cuttings. Overall, the cuttings better as most parameters measured were significantly higher than the control.

South African Journal of Botany 139 (2021) 294–299

Ex vitro vegetative propagation technique for sustainable utilization of *Hypoxis hemerocallidea* cormsMotiki M. Mofokeng^{a,b,*}, Hints T. Araya^{a,b}, S.O. Amoo^{a,c}, C.P. du Plooy^a, P.W. Mashela^b^a Agricultural Research Council—Vegetables, Industrial and Medicinal Plants (ARC-VIMP), Private Bag X293, Pretoria 0001, South Africa^b Green Technologies Research Centre, University of Limpopo, Private Bag X1106, Sovenga 0727, South Africa^c Department of Botany and Plant Biotechnology, University of Johannesburg, P.O. Box 524, Auckland Park 2006, Johannesburg, South Africa

ARTICLE INFO

Article History:

Received 25 August 2020

Revised 10 December 2020

Accepted 2 March 2021

Available online xxx

Edited by OO Olarewaju

Keywords:

African potato

Benzyladenine

Corm cuttings

Cormlets

Corm segments

Gibberellic acid

ABSTRACT

Hypoxis hemerocallidea is a highly utilized medicinal plant, with the potential to treat testicular tumors, prostate hypertrophy and urinary infections. Although currently classified as of least concern in its conservation status, its ongoing, unsustainable harvesting and habitat loss remain threats to its natural populations. The potential of using one-half of *H. hemerocallidea* corms for propagation and the other half for medicinal purposes was investigated in an effort to develop sustainable utilization strategies for this plant. The corms were cut transversely into upper and lower halves, following which the upper halves were either cut into four or eight equal segments, or used without any further cutting. The segments were soaked for 30 min in 6-benzyladenine (BA) or gibberellic acid (GA₃) at concentrations of 50 or 100 mg/L, while soaking in distilled water served as the control. Upper parts of the corm cut into four segments, and soaked in 50 mg/L BA resulted in a high number of cormlets. The propagation coefficient of the upper corm parts cut into four segments and soaked in 50 mg/L BA was 140%. The cutting method alone or combined with plant growth regulator treatments significantly affected the number of cormlets produced. Cutting the upper corm parts into four segments and soaking in distilled water resulted in a propagation coefficient of 90%. Cutting the upper corm parts into four segments is advantageous as the segments are not too small to compromise food reserves, while soaking allows for the leaching out of possible growth retardants. The study successfully developed a method, which can be recommended for sustainable harvesting and propagation of *H. hemerocallidea*.

RESEARCH REPORT

*Hypoxis hemerocallidea* cormlet production in response to corm cutting and exogenous application of plant growth regulatorsMotiki Meshack Mofokeng^{1,2} , Hints T. Araya^{1,2} , Stephen Oluwaseun Amoo¹ , Christian Philippus du Plooy¹ · Phatu William Mashela² 19 / Revised: 22 May 2020 / Accepted: 17 June 2020 / Published online: 18 August 2020
Horticultural Science 2020

Article

NADES Compounds Identified in *Hypoxis hemerocallidea* Corms during DormancyMotiki M. Mofokeng^{1,2,*} , Gerhard Prinsloo³ , Hints T. Araya^{1,*} , Stephen O. Amoo^{1,4,*} , Christian P. du Plooy¹ and Phatu W. Mashela²

- 1 Agricultural Research Council—Vegetable, Industrial and Medicinal Plants (ARC-VIMP), Private Bag X293, Pretoria 0001, South Africa
 - 2 Green Technologies Research Centre, University of Limpopo, Private Bag X1106, Sovenga 0727, South Africa
 - 3 Department of Agriculture and Animal Health, University of South Africa, Private Bag X6, Johannesburg 1710, South Africa
 - 4 Department of Botany and Plant Biotechnology, University of Johannesburg, P.O. Box 524, Auckland Park, Johannesburg 2006, South Africa
- * Correspondence: mofokengm@arc.agric.za (M.M.M.); arayah@arc.agric.za (H.T.A.); amoo@arc.agric.za (S.O.A.); Tel.: +27-12-808-8000 (M.M.M. & H.T.A. & S.O.A.)

Abstract: Soaking *Hypoxis hemerocallidea* corms in distilled water improved the propagation and development of cormlets, suggesting the potential leaching-out of inhibitory chemical compounds. To investigate the presence of inhibitory compounds, nuclear magnetic resonance (NMR) spectral data of the leachate from dormant *H. hemerocallidea* corms were obtained using a 600 MHz ¹H-NMR spectrometer. The ¹H-NMR analysis led to the identification of choline, succinate, propylene glycol, and lactose, as inhibitory compounds. These four chemical compounds are part of the “Natural Deep Eutectic Solvents” (NADES) that protect plant cells during stress periods, each of which has the potential to inhibit bud growth and development. These compounds are supposedly leached out of the corms during the first rain under natural conditions, possibly accompanied by changes in the ratios of dormancy-breaking phytohormones and inhibitory compounds, to release bud dormancy. The identified chemical compounds heralded a novel frontier in the vegetative propagation of *H. hemerocallidea* as a medicinal plant, and for its enhanced sustainable uses.

Hort and Soil 2018, 35(5): 359–365
All rights reserved© Southern African Plant & Soil Sciences Committee
SOUTH AFRICAN JOURNAL OF
PLANT AND SOIL
ISSN 0257-1862 EISSN 2167-034X
<https://doi.org/10.1080/02571862.2018.1443350>Propagation of *Hypoxis hemerocallidea* by inducing corm budsMotiki M Mofokeng^{1,2*} , Riana Kleynhans³ , Lesego M Sediane¹, Liesl Morey⁴ and Hints T Araya^{1,2} ¹ Agricultural Research Council—Roodeplaat, Vegetable and Ornamental Plants, Pretoria, South Africa² Green Technologies Research Centre, University of Limpopo, Sovenga, South Africa³ Department of Horticulture, Tshwane University of Technology, Pretoria, South Africa⁴ Agricultural Research Council—Biometry, Corporate Office, Pretoria, South Africa

* Corresponding author, email: MofokengM@arc.agric.za

African potato is facing rapid decline of wild populations due to large-scale harvesting, necessitating efficient means of propagation. Propagation of African potato is difficult due to seed dormancy and the species does not naturally propagate easily from corms. This study aimed to develop a simple and affordable propagation protocol for African potato. Chipping, scooping and cross-cutting methods were used to expose buds on small, medium and large African potato corms. There were no significant differences in number of ‘daughter corms’ between chipping and scooping for the large corms, as well as chipping and scooping for medium and small corms at the end of the experiment. Cross-cutting did not lead to formation of ‘daughter corms’. The number of leaves on ‘daughter corms’ was only significantly higher in the scooped medium corms compared with chipped small corms at the end of the experiment. Chipping showed a significantly higher number of roots compared with scooping. The chipping and scooping methods resulted in fully developed ‘daughter corms’ planted individually. These methods can be recommended for multiplication of African potato corms. This study provided novel and relatively affordable methods for *in vivo* multiplication of African potato, which can potentially help conserve wild populations.

SUMMARY - PROPAGATION STUDIES

- Multiplication of plant material – effects on final product
- Availability – at reasonable costs, effects on product pricing
- Seed propagation – dormancy, germination conditions
- Variation – between plants and populations, quality variations
- Vegetative propagation – cutting technique, rooting, conditions
- True-to-type material





The effects of season and water availability on chemical composition, secondary metabolites and biological activity in plants

G. Prinsloo · N. Nogemane



Received: 15 January 2018 / Accepted: 29 March 2018 / Published online: 4 April 2018
© Springer Science+Business Media B.V., part of Springer Nature 2018

Abstract Plants react towards changes in their environment, which can be a result of biotic or abiotic activities. Numerous studies have investigated the effects of abiotic stress on plants, and how it affects the primary as well as secondary metabolism. Generally it is accepted that plants react to environmental stress by increasing secondary metabolites. This is however a very broad and simplified explanation and often inaccurate. Various examples are provided where plants react positively, and often negatively towards seasonal variation and water availability, resulting in a lowering of certain secondary metabolites concentra-

Keywords Season · Water · Irrigation · metabolites · Metabolic pathways · Flavor

Introduction

It is commonly known that abiotic as well as biotic factors influence the chemical composition of plants. The effect of abiotic factors such as growth conditions, temperature, light, nutrients, water availability, and water stress have been well studied to determine the impact on the



Contents lists available at ScienceDirect

South African Journal of Botany

journal homepage: www.elsevier.com/locate/sajb



Metabolomic profiling of *Greyia radlkoferi* on water stress, phenological growth stages, and leaf age using ^1H NMR

Joseph Malele^{a,*}, Riana Kleynhans^a, Gerhard Prinsloo^b, Babalwa Matsiliza-Mlathi^a

^a Department of Horticulture, Tshwane University of Technology, Private Bag X680, Pretoria 0001, South Africa

^b Department of Agriculture & Animal Health, UNISA, Private Bag X6, FL 1710, United States



ARTICLE INFO

Article History:
Received 29 April 2024
Revised 15 August 2024
Accepted 16 August 2024
Available online 21 August 2024

Edited by Dr V. Kumar

Keywords:
Anti-tyrosinase
Greyia radlkoferi
Phenology
Water stress

ABSTRACT

Greyia radlkoferi Szyszyl (Melianthaceae) is a native plant to southern Africa identified as a viable commercial crop. The leaf extract is rich in flavonoid compounds with the ethanolic leaf extract found to treat skin hyperpigmentation of humans without adverse effects (anti-tyrosinase activity value IC_{50} 17.86 $\mu\text{g/ml}$). Anti-tyrosinase activity is found to be variable between plants, even when planted at the same site, which raises concerns regarding commercial production, necessitating the need for cultivation interventions that will not compromise the activity of the extract. Interventions to limit the variation were thus explored by imposing targeted water stress (different durations) before harvesting and determining the effect on the different phenological growth stages and activity of different leaf ages. The inhibitory tyrosinase activity was evaluated using mushroom tyrosinase and kojic acid as a control and data was presented as IC_{50} values. The metabolomics investigation was conducted through the use of nuclear magnetic resonance (^1H NMR) analysis coupled with the multivariate statistical data set. Pattern recognition methods such as principal component analysis (PCA) and orthogonal projection on latent structure-discriminant analysis (OPLS-DA) were employed to obtain the metabolic discrimination between the treatments. No clear pattern was observed in the grouping of samples exposed to targeted water stress on both plant age and leaf position, except for younger leaves of one month and four months old which had a strong clustering of high activity samples as compared to older leaves of six months old. However, plant materials harvested during the flowering growth stage had a strong grouping of samples producing high anti-tyrosinase activity as compared to the budding and vegetative growth stages. The study determined the changes in the concentration of various compounds, although quantification of compounds should be determined in the future.

© 2024 Published by Elsevier B.V. on behalf of SAAB

Yield and Metabolite Production of *Pelargonium sidoides* DC. in Response to Irrigation and Nitrogen Management

Motiki M. Mofokeng^{1,2,*}, Gerhard Prinsloo³, Hintsa T. Araya¹, Christian P. du Plooy¹, Ntshakga R. Sathekge^{1,†}, Stephen O. Amoo¹ and J. Martin Steyn²

¹ Agricultural Research Council, Roodeplaat-Vegetable and Ornamental Plant (ARC-VOP), Pretoria 0001, South Africa; arayah@arc.agric.za (H.T.A.); iduplooy@arc.agric.za (C.P.d.P.); amoos@arc.agric.za (S.O.A.)

² Department of Plant and Soil Sciences, University of Pretoria, Hatfield, Pretoria 0002, South Africa; martin.steyn@up.ac.za

³ Department of Agriculture and Animal Health, University of South Africa, Science Campus, Johannesburg 1710, South Africa; prinsg@unisa.ac.za

* Correspondence: mofokengm@arc.agric.za; Tel.: +27-12-808-8000

† Deceased.

Received: 9 April 2020; Accepted: 21 May 2020; Published: 27 May 2020



Abstract: Competition for water between agricultural and non-agricultural economic sectors hampers agricultural production, especially in water-scarce regions. Understanding crop responses in terms of yield and quality to irrigation is an important factor in designing appropriate irrigation management for optimal crop production and quality. *Pelargonium sidoides* DC., often harvested from the wild, is in high demand in the informal market and for commercial formulations. Agricultural production of high-quality materials through cultivation can help reduce pressure on its wild populations. This



Growth of *Pelargonium sidoides* DC. in response to water and nitrogen level

M.M. Mofokeng^{a,b,*}, J.M. Steyn^b, C.P. du Plooy^a, G. Prinsloo^c, H.T. Araya^a

^a ARC - Roodeplaat VOPI, Private Bag X293, South Africa, Pretoria, 0001

^b Department of Plant Production and Soil Science, University of Pretoria, South Africa, Pretoria, 0001

^c College of Agriculture and Environmental Sciences, University of South Africa, Private Bag X6, South Africa, Johannesburg, 1710

ARTICLE INFO

Article history:

Received 24 November 2014

Received in revised form 25 March 2015

Accepted 22 May 2015

Available online xxxx

Edited by J van Staden

Keywords:

Allowable depletion

Growth response

Nitrogen

Pelargonium sidoides

Stomata

Water stress

ABSTRACT

Water stress is the most limiting factor in agricultural productivity in arid and semi-arid regions and causes very high losses in crop yield. Regulation of growth and stomatal conductance are the main mechanisms by which plants respond to water stress. *Pelargonium sidoides* is a medicinal plant that grows in South Africa and is used for the treatment of upper respiratory ailments. Cultivation has been considered as a viable means of reducing the pressure on natural populations of this species, but little to no information is available in this regard. Water and nitrogen supply are two of the most important factors that affect growth and yield of plants. This study therefore aimed at investigating the physiological and morphological response, in relation to growth, of *P. sidoides* to soil water and nitrogen levels. To achieve this objective, *P. sidoides* plants were grown under a rainshelter and exposed to three irrigation levels (well watered control, moderate water stress, and severe water stress treatment) and four nitrogen levels (0, 50, 100, and 150 kg · N · ha⁻¹). Nitrogen and water level had no significant interaction effect on measured parameters. Water stress significantly reduced stomatal conductance, while nitrogen had no significant effect on it. The well watered control had a significantly higher leaf area index, plant height, leaf area, and fresh root yield compared to the water stressed treatments. Nitrogen level had a significant effect on number of leaves, where 100 kg · N · ha⁻¹ had a significantly higher number of leaves compared to other nitrogen treatments. The study provides a first report on the response of *P. sidoides*

Article

Evaluating Growth, Yield, and Water Use Efficiency of African and Commercial Ginger Species in South Africa

Auges Gatabazi ^{1,*}, Diana Marais ¹, Martin J. Steyn ¹, Hints T. Araya ²,
Motiki M. Mofokeng ² and Salmina N. Mokgehele ²

- ¹ Department of Plant and Soil Sciences, University of Pretoria, Pretoria 0002, South Africa; Diana.Marais@up.ac.za (D.M.); Martin.Steyn@up.ac.za (M.J.S.)
 - ² Agricultural Research Council, Vegetable and Ornamental Plant (VOP), Private Bag X293, Pretoria 0001, South Africa; Arayah@arc.agric.za (H.T.A.); MofokengM@arc.agric.za (M.M.M.); MokgeheleNS1@arc.agric.za (S.N.M.)
- * Correspondence: auges2012@gmail.com

Received: 28 November 2018; Accepted: 12 March 2019; Published: 16 March 2019



Abstract: Ginger species play an important economic role as medicinal plants, food flavourings and dietary supplements. Products from ginger, used to treat malaria, asthma, headaches, and ac The cultivation of wild plant species can alleviate Under cultivation, the major constraints on crop nutrition. Therefore, the impact of water stress on

ACTA AGRICULTURAE SCANDINAVICA, SECTION B — SOIL & PLANT SCIENCE, 2017
<http://dx.doi.org/10.1080/09064710.2017.1293723>

Antioxidant activity and soluble sugars of African ginger (*Siphonochilus aethiopicus*) in response to irrigation regimen and nitrogen levels

S. N. Mokgehele^{a,b}, S. Z. Tesfay^a, H. T. Araya^b and C. P. du Plooy^b

^aDepartment of Horticultural Science, School of Agricultural, Earth and Environmental Sciences, University of KwaZulu-Natal, Pietermaritzburg, South Africa; ^bARC-Rooderlaat, Vegetable and Ornamental Plant, Pretoria, South Africa

ABSTRACT

African ginger (*Siphonochilus aethiopicus*), as a medicinal plant, is known for its medicinal properties, containing various antioxidant compounds and carbohydrates. Rhizome yield is improved by water regimens and fertilizers applied at plant phenological stages. However, the rhizomatous herb, which is traditionally used for the treatment of asthma, inflammation and malaria has limited information on water and nitrogen requirements for its production. This study assessed the effect of irrigation regimens (30%, 50% and 70% allowable depletion level (ADL) and nitrogen (N) levels (0, 50, 100, 150 and 200 kg ha⁻¹) on antioxidant activity and carbohydrates on plant leaf, root and rhizome. The interaction treatment effect of severely stressed (70% ADL) with the N application of 100 kg ha⁻¹ had significant effect on leaf phenolic concentration (87.02 ± 2.51 mg g⁻¹ gallic acid equivalent). Interaction effect of moderately stressed (50% ADL) and severely stressed (70% ADL) treatment with N application rate of 0 kg ha⁻¹ had significant effect on plant flavonoids and phenolics in all plant parts. In plant carbohydrates, root had high sucrose content (47.68 ± 9.0 mg g⁻¹ dry weight) with the application of low N (0 kg ha⁻¹) grown under severely stressed treatment. In conclusion, this implies that different *S. aethiopicus* parts can produce substantial amount of antioxidants and carbohydrates, as exhibited under low N and reduced water supply applied during the phenological cycle.

Growth and yield of African ginger in response to application of organic fertiliser

Phomolo Maphothoma^{1,2}, Riana Kleynhans³, Gerhard Prinsloo², Salmina N Mokgehele¹, Ian du Plooy¹ and Hints T Araya^{1*}

- ¹ Agricultural Research Council–Rooderlaat: Vegetables, Industrial and Medicinal Plants, Pretoria
 - ² Department of Agriculture and Animal Health, University of South Africa (UNISA), Florida
 - ³ Department of Horticulture, Tshwane University of Technology, Pretoria
- * Correspondence: arayah@arc.agric.za

African ginger (*Siphonochilus aethiopicus*) is in high demand for medicinal use. The plant does not multiply after being harvested, as it is destroyed in the process. The species is now facing extinction as a result of over harvesting. In order to mitigate this threat, cultivation of the species has become priority. The objective of this study was to determine the growth and yield parameters of *S. aethiopicus* in relation to organic fertiliser treatments. The parameters were evaluated in



ns (0, 100 and 200 kg N ha⁻¹) and three rhizome sizes, namely small (10–20 g), combination of a fertiliser application of 100 kg N ha⁻¹ and large rhizomes rhizome yield (7 t ha⁻¹) and root yield (6 t ha⁻¹). Small and medium rhizomes had s at all nitrogen levels. The different fertiliser applications were associated with nt. It is concluded that the application of 100 kg N ha⁻¹ and planting of large rican ginger's commercial production.

its, rhizomes, *Siphonochilus aethiopicus*, stomatal conductance

ARTICLE HISTORY

Received 20 October 2016
Accepted 30 January 2017

KEYWORDS

Fertilizer effects; plant secondary metabolites; water deficits; soil moisture

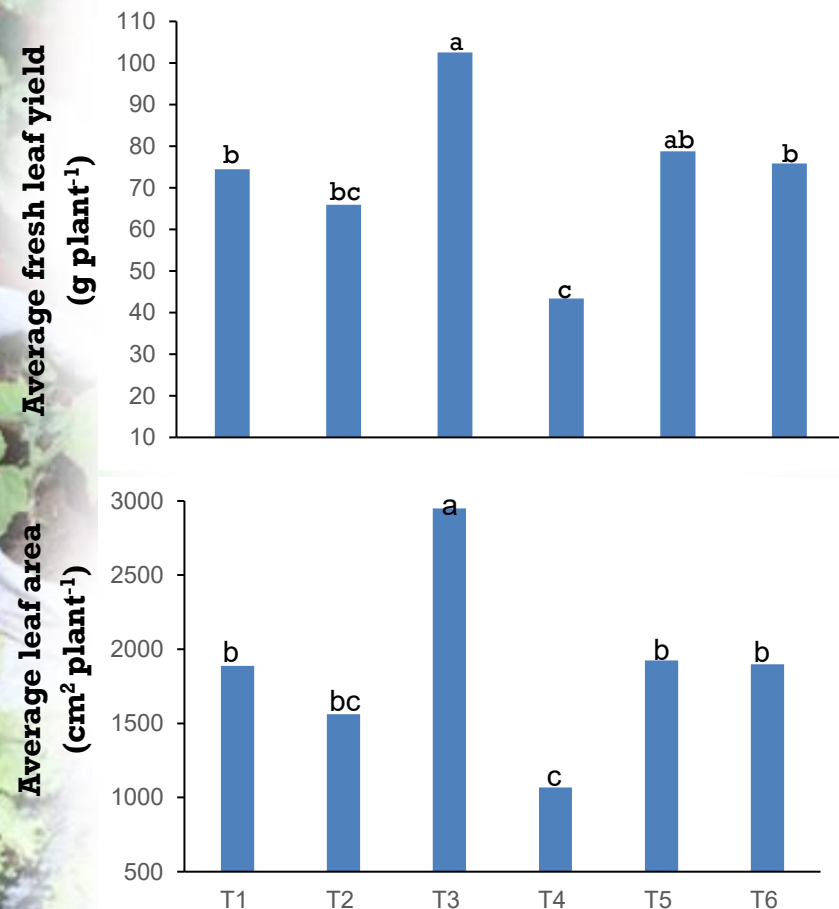
SUMMARY - AGRONOMIC RESEARCH

- Water stress studies - deficit irrigation, terminal water stress, watering frequency
- Nutrient stress - macro nutrients (N, P, K), micro nutrients
- Increased yields, less to no effects on quality
- At times increase content of compounds
- Other factors
 - Shading, spacing, mulching, etc.





Table 1. Annotated chemical content of *G. radlkoferi* in response to water stress



Treatment	Compounds	Chemical shift	Reference
Treatment 1-4	Epigallocatechin	2.74	Valcic et al., 2000 Le Gall et al., 2004
		6.01	
		6.05	
		7.05	
	Gallocatechin	5.84	Medimagh et al., 2010 Nogemane, 2017
		6.66	
	Galangin	7.50-7.55 8.14	Zhang et al., 2016
	Catechin	5.90	Abd El-Razek, 2007
		5.98	
		6.10	
	2',4',6'-Trihydroxy-chalcone	1.97	Rapado et al., 2014
		5.89	
		7.44	
		7.56	
		7.93	
		8.12	
	2',4',6'-Trihydroxy-dihydrochalcone	2.73	Rapado et al., 2014
		5.90	
		7.21	
		7.30	
Treatments 5 & 6	Pinocembrin	6.21	Li et al., 2012 Nyokat et al., 2017
		7.50-7.70	

T1=100% of the **depleted water** once a week;
T2=100% of the **depleted water** twice a week;
T3=100% of the **depleted water** thrice a week;
T4=75% of the **depleted water** once a week;
T5=50% of the **depleted water** twice a week;
T6=50% of the **depleted water** thrice a week.

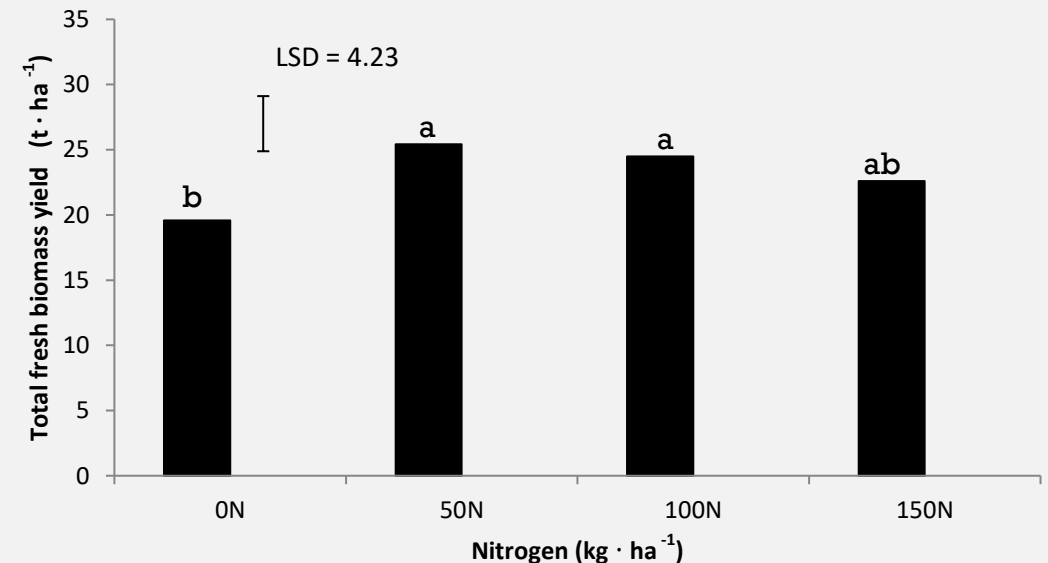
PELARGONIUM SIDOIDES AGRONOMY



Table 2. Root yield and root dry matter content of *P. sidoides* under different water-stressed conditions.

Water depletion (% *ADL)	Fresh root yield (t · ha ⁻¹)	Dry root yield (t · ha ⁻¹)	Average dry matter content (%)
30	19.77 ^a	3.58 ^a	27.24 ^a
50	14.52 ^b	2.51 ^b	24.58 ^b
70	14.05 ^b	2.15 ^b	25.57 ^{ab}
LSD_{0.05}	2.81	0.59	1.93

Treatments	Esculin	Scopoletin	Umckalin
N* (kg ha ⁻¹)	mg 100 g ⁻¹		
0	27.6	3.4	42.5
50	29.5	3.5	45.3
100	24.9	4.5	38.3
150	25.4	4.8	39.0
ADL* (% PAW)	mg 100 g ⁻¹		
30	26.2	4.2	40.3
50	26.4	4.4	40.6
70	27.9	3.6	42.9
N X ADL	NS	NS	NS



PESTS AND DISEASES

A new record of mealybugs (*Paracoccus burnerae* Brain – Hemiptera: Pseudococcidae) and leafhoppers (*Mnengia angusta* Theron – Cicadellidae: Coelidiinae) on a southern African medicinal plant, *Greyia radlkoferi*

M.M. Mofokeng^{1*}, D.M. Sehlola², H.T. Araya¹, S.O. Amoo¹ & C.P. du Plooy¹

¹Crop Science Division, Agricultural Research Council – Vegetable and Ornamental Plants (ARC-VOP), Private Bag X293, Pretoria, 0001 South Africa

²Crop Protection Division, Agricultural Research Council – Vegetable and Ornamental Plants (ARC-VOP), Private Bag X293, Pretoria, 0001 South Africa

Cultivation of medicinal plants at a commercial scale brings with it challenges such as pests and diseases. In their natural habitat, medicinal plants may generally be less infested with pests and diseases, whereas they may be severely attacked in agro-ecosystems (Verma 2006). The feasibility and to overcome skin irritations (Lall *et al.* 2016; Nogemane & Prinsloo 2018). Realising the potential for cosmeceutical product development from *G. radlkoferi* demands that the species be produced

on a commercial scale for a sustainable supply of the plant material (Nogemane & Prinsloo 2018). Production of good quality finished products depends, amongst others, on the quality of raw medicinal plant material supplied (Nogemane 2017). Wild harvested medicinal plants present search Council–Plant Health and Protection (ARC-PHP) for identification using gross morphological traits, after which they were assigned with accession numbers and deposited in the National



*Author for correspondence. E-mail: mofokengm@arc.agric.za

Received 23 December 2019. Accepted 11 April 2020

ISSN 1021-3589 [Print]; 2224-8854 [Online]
DOI: <https://doi.org/10.4001/003.028.0465>

African Entomology 28(2): 465–468 (2020)
©Entomological Society of Southern Africa

academicJournals

Vol. 5(4), pp. 38–41, July 2013

DOI: 10.5897/JEN2012.0061

ISSN 2006-9855 ©2013 Academic Journals

<http://www.academicjournals.org/JEN>

Journal of Entomology and Nematology

Full Length Research Paper

Estimation of *Pelargonium sidoides* root damage by *Meloidogyne* spp.

M. M. Mofokeng^{1*}, D. Visser¹, R. Kleynhans¹, C. P. Du Plooy¹, G. Prinsloo² and P. Soundy³

¹Agricultural Research Council, Roodeplaat Vegetable and Ornamental Plant Institute (ARC-VOPI), P/Bag X293, Pretoria, 0001, South Africa.

²Department of Agriculture and Animal Health, College of Agriculture and Environmental Sciences, University of South Africa, Florida campus, Private Bag X6 Florida, 1710, South Africa.

³Department of Crop Sciences, Tshwane University of Technology, Private Bag X680, Pretoria, 0001, South Africa.

Accepted 7 June, 2013

Pelargonium sidoides is a medicinal plant species indigenous to Southern Africa. Its roots are used for treating a variety of ailments in man and livestock. It is in great demand by local users and international pharmaceutical producers. Root-knot nematodes, *Meloidogyne* species, penetrate into the roots of





CONCLUSIONS

- Cultivation – important in development of formal medicinal plant industry
- Response of commercially important medicinal plants
- Information on effects on yield and quality
- Optimized and standardized cultivation procedure
- Manipulation of environmental conditions – quality
- Better prices – quality and traceability
- Production and market demand – balance
- Harvesting and post harvest management

ACKNOWLEDGEMENTS

- Collaborators – UNISA, TUT, UP, UL
- Students
- Funders –DSTI, DoA, DFFE
- Agricultural Research Council

