

# Diversity and ecological state of aromatic plants

**Ben-Erik Van Wyk**

DST-NRF SARCHI National Research Chair in Indigenous Plant Use,  
University of Johannesburg, South Africa  
bevanwyk@uj.ac.za

**2nd South African Conference on essential and vegetable oils**  
**Hatfield Hotel, Pretoria, 21-22 July 2022**



# Diversity and ecological state of aromatic plants

## POTENTIAL FOR CREATING NEW HORIZONS FOR THE SOUTH AFRICAN ESSENTIAL OIL INDUSTRY?

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**Scientific exploration and commercial evaluation of  
all aromatic plants of the world  
are necessary to maximize the potential benefits of the  
available botanical, chemical and ecological diversity**

**Two possible options (both require detailed inventories):**

- 1. Start to produce oils from species that already have a proven market  
(i.e., compete with existing producers for existing markets)**
- 2. Research and develop new essential oil crops from indigenous plants  
(i.e., create new products and new markets – numerous  
indigenous aromatic plants have not yet been explored).**



# HISTORICAL PERSPECTIVES ARE IMPORTANT:

They provide the first clues to potentially valuable products

They provide important data for research, development and marketing

Ancient African origins



Frankincense / Church Frankincense



*Bet Giyorgis*, masterpiece amongst the rock-hewn churches of Lalibela



Frankincense (church frankincense) - *Boswellia papyrifera*

# HISTORICAL PERSPECTIVES ARE IMPORTANT:

Ancient African origins

Myrrh



Myrrh

(*Commiphora myrrha*, Burseraceae)

# HISTORICAL PERSPECTIVES ARE IMPORTANT:

## Ancient African origins



## Frankincense is an essential part of the Ethiopian coffee ceremony



Coffee (*Coffea arabica*) – flowers, fruits



Essential oils from the main types of Ethiopian resins

# HISTORICAL PERSPECTIVES ARE IMPORTANT:

## Ancient African origins



**“.... !nkaou is rare and valuable, and a thimbleful is worth from a sheep to an ox. It is obtained in mountainous districts...”**

**(Laidler, 1928, recorded in the Kamiesberg)**

## Buchu (round-leaf buchu, !nkaou )



**Round-leaf buchu – *Agathosma betulina***

# HISTORICAL PERSPECTIVES ARE IMPORTANT:

Ancient African origins

“*Bushmen*” means

“aromatic bush people”,

i.e., the people (*qua*) who habitually anoint their bodies with aromatic bushes (*san* or *son* or *buchu*)

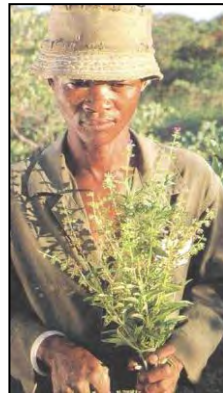
The *Sanqua* or *Sonqua* (Bushmen) are named after aromatic plants



San healer women (Central Kalahari)



Bird nest and tortoise shell as a containers for *buchu* powder



“male” buchu (*Syncolostemon bracteosus*)



“female” buchu (*Ocimum filamentosum*)



San or Son (*Pteronia onobromoides*)





# BOTANICAL AND CULTURAL DIVERSITY ARE IMPORTANT:

They provide the first clues to potentially valuable “NEW” products

They provide important “NEW” data for research, development and marketing

## DIVERSITY

## Ogaden-type frankincense



## Ogaden-type frankincense

[*Mirafur* (Amharic)]

(*Boswellia rivae*, Burseraceae)

# BOTANICAL AND CULTURAL DIVERSITY ARE IMPORTANT:

## DIVERSITY

## Borena-type frankincense



## Borena-type frankincense

[*Dakara*, *Afan Oromo* (Amharic)]

(*Boswellia neglecta*, Burseraceae)

# BOTANICAL AND CULTURAL DIVERSITY ARE IMPORTANT:

## DIVERSITY



## Scented myrrh (opopanax)



## Scented myrrh, opopanax (*Commiphora guidottii*, Burseraceae)

# BOTANICAL AND CULTURAL DIVERSITY ARE IMPORTANT:

## DIVERSITY

## son / buchu plants used by San and Khoi people



round-leaf buchu/  
!nkaou  
*Agathosma betulina*



oval-leaf buchu  
*Agathosma crenulata*



long-leaf buchu  
*Agathosma serratifolia*



buchu, bokboegoe  
*Diosma hirsuta*



haasboegoe  
*Diosma aspalathoides*



boegoekaroo  
*Pteronia adenocarpa*



!noraboegoe  
*Pteronia aspera*



boegabos  
*Pteronia divaricata*



san or son  
*Pteronia onobromoides*



ghwarrieson  
*Pegolettia baccharidifolia*

# URGENT NEED TO RECORD TRADITIONAL USES OF PLANTS

## Earliest publications on buchu and its uses by San and Khoi people



Kolbe (1719)

Title page of Kolb (1719)



*Spiraea Africana Odorata* in Kolbe (1719)



Thunberg (1799)



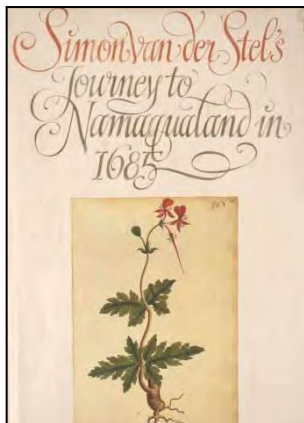
Title page of Thunberg's *Dissertatio Botanica de Diosma* (1799)



buchu (*Diosma acmaeophylla*)



Simon van der Stel (1685)



Facsimile edition, 1979



Page 206: San or Son (*Pteronia onobromoides*)



Commelin (1692, 1706)



*Spiraea Africana Odorata* in Commelin (1706)



San or Son (*Pteronia onobromoides*)

**Scientific exploration and commercial evaluation of all aromatic plants of the world are necessary to maximize the potential benefits of the available botanical, chemical and ecological diversity**

**Two possible options (both require detailed inventories):**

- 1. Start to produce oils from species that already have proven markets (i.e., compete with existing producers for existing markets)**
- 2. Research and develop new essential oil crops from indigenous plants (i.e., create new products and new markets – numerous indigenous aromatic plants have not yet been explored).**



# REVIEWS AND INVENTORIES ARE IMPORTANT:

They provide a bird's eye view (global perspective)

They provide lists and data for new innovations

examples of reviews of commercialised medicinal and aromatic plants



Global reviews  
of commercialised  
medicinal and  
aromatic plants

Southern African  
reviews

## Option 1. Compete with existing producers in existing markets:

An inventory of commercialized aromatic plants is needed.

What sources of information are available for such an inventory?

### Available databases on essential oils

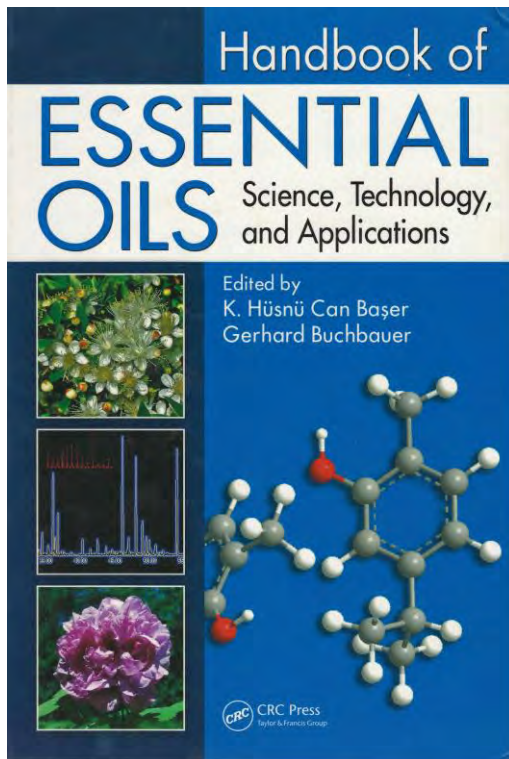
Feature	EssOilDB	EOUdb	AromaWeb	Phytochemical and Ethnobotanical Databases	The Cropwatch Files
<b>Oil composition Break up</b>	Provided with amounts	Provided with amounts	Provided without amount	Not provided	Provided in few cases
<b>No. of Plant Species</b>	<b>1528</b>	826	107	<b>2376</b>	About 20 species
<b>Taxonomic families</b>	78	97	Not Provided	Provided	Not Provided
<b>Origin of Data</b>	Global	Global	Not Provided	Not provided	Provided
<b>No. of Essential Oils</b>	<b>2868</b>	2571	110	Not provided specifically	Not specifically provided
<b>Citation Details</b>	Provided	Provided	Provided	Provided	Provided
<b>Statistical Analysis</b>	Enabled	Not possible	Not possible	Not possible	Not Possible
<b>Invasive Plant info</b>	Provided	Not provided	Not Provided	Not Provided	Not Provided
<b>Stress related Data</b>	Provided	Not Provided	Not Provided	Not Provided	Not Provided
<b>Chemical structure</b>	Provided	Provided for few	Not Provided	Not Provided	Provided for few
<b>Identification Method</b>	Provided	Not Provided	Not Provided	Not Provided	Provided in some case
<b>Extraction method</b>	Provided	Not Provided	Provided	Not Provided	Provided
<b>Chemical category</b>	Provided	Not Provided	Not Provided	Not Provided	Provided
<b>Plant source organ</b>	Provided	Not Provided	Provided	Provided	Not Provided
<b>Biological Activity</b>	Provided	Not Provided	Not Provided	Provided	Not provided
<b>CAS number</b>	Provided	Provided	Not Provided	Not Provided	Not provided



## Option 1. Compete with existing producers in existing markets:

An inventory of commercialized aromatic plants is needed.

What sources of information are available for such an inventory?

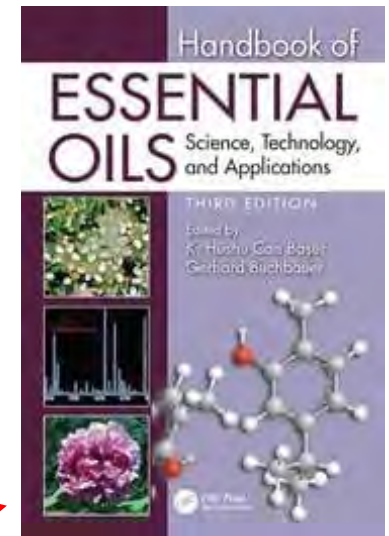


**HANDBOOK OF ESSENTIAL OILS:  
Science, Technology and Applications**

**Edited by:  
K. Hüsnü Can Başer  
Gerhard Buchbauer**

**CRC Press  
Taylor & Francis**

**ca. 1200 pages  
1st Edn. : January 2010  
2nd Edn. : January 2016  
3rd Edn. : January 2020**



## Most important essential oils in international trade (by volume)

Oil	Source	Prod. (Ton)	Value \$ (000)	\$/kg	Producer country
Orange	<i>Citrus sinensis</i>	55.000	440.000	8	Brazil, USA, Israel, Argentina, Mexico, Spain, <b>S. Africa</b>
Cornmint	<i>Mentha canadensis</i>	40.000	720.000	18	India
Eucalyptus oil – Cineole type	<i>Eucalyptus globulus</i>	11.000	330.000	30	China, India
Lemon	<i>Citrus limon</i>	7.500	262.500	35	Italy, Spain, Argentina, Israel, USA
Scotch spearmint	<i>Mentha x gracilis</i>	3.650	-	-	USA
Peppermint	<i>Mentha x piperita</i>	3.300	132.000	40	USA, India
Mustard (incl. cold-pressed oil)	<i>Brassica nigra, B. juncea</i>	3.000	600.000	200	India
Clove leaf	<i>Syzygium aromaticum</i>	2.560	56.320	22	Indonesia, Madagascar, Zanzibar, Brazil, Sri Lanka
Lavender	<i>Lavandula officinalis</i>	2.100	73.500	35	France, Bulgaria, Spain
Lavandin grosso	<i>Lavandula x intermedia</i>	2.100	73.510	35	France, Bulgaria, Spain
Lime	<i>Citrus aurantiifolia</i>	1.900	76.000	40	Mexico, Peru, Brazil
Litsea cubeba	<i>Litsea cubeba</i>	1.700	34.000	20	China
Camphor	<i>Cinnamomum camphora</i>	1.520	45.600	30	Taiwan
Patchouli	<i>Pogostemon cablin</i>	1.600	64.000	40	Indonesia, India
Citronella	<i>Cymbopogon winterianus + C. nardus</i>	1.100	33.000	30	China, Indonesia, India
Cedarwood (Chinese)	<i>Cupressus funebris</i>	1.000	-	-	China

Source: Lecture by K. Hüsnu Can Başer “GLOBAL TRADE AND POTENTIAL OF ESSENTIAL OILS”

## Most important essential oils in international trade (by value)

Oil	Source	Prodn. (Ton)	Value \$ (000)	\$/kg	Producer country
Cornmint	<i>Mentha canadensis</i>	40.000	720.000	18	India
Sandalwood oil album	<i>Santalum album</i>	300	690.000	2.300	India (ban but illegal cut), Australia, New Caledonia (lower quality)
Mustard (incl. cold-pressed oil)	<i>Brassica nigra</i> , <i>B. juncea</i>	3.000	600.000	200	India
Orange	<i>Citrus sinensis</i>	55.000	440.000	8	Brazil, USA, Israel, Argentina, Mexico, Spain, <b>S. Africa</b>
Eucalyptus oil – Cineole type	<i>Eucalyptus globulus</i>	11.000	330.000	30	China, India
Lemon	<i>Citrus limon</i>	7.500	262.500	35	Italy, Spain, Argentina, Israel, USA
Vetiver	<i>Vetiveria zizanioides</i>	500	200.000	400	Indonesia, Haiti, India, China
Immortelle	<i>Helichrysum italicum</i>	100	180.000	1.800	France, Italy, Croatia
Peppermint	<i>Mentha x piperita</i>	3.300	132.000	40	USA, India
Lavender	<i>Lavandula angustifolia</i>	750	127.500	170	Bulgaria, France, China, Russia
Rose oil and Concrete	<i>Rosa damascena</i>	14(C) 7(O)	126.000 63.000	9000 (O)	Bulgaria, Turkey
Frankincense (Olibanum)	<i>Boswellia serrata</i>	400	120.000	300	India
Sandalwood oil spicatum	<i>Santalum lanceolatum</i> , <i>S. spicatum</i>	100	120.000	1.200	New Caledonia, Australia, India
Sandalwood oil Queensland	<i>Santalum spicatum</i>	50	100.000	2.000	Australia
Grapefruit	<i>Citrus paradisi</i>	800	92.000	115	Mexico, Brazil, <b>S. Africa</b>
Frankincense (Olibanum)	<i>Boswellia sacra</i> ( <i>B. carteri</i> )	300	90.000	300	Somalia, Oman

Source: Lecture by K. Hüsnü Can Başer “GLOBAL TRADE AND POTENTIAL OF ESSENTIAL OILS”

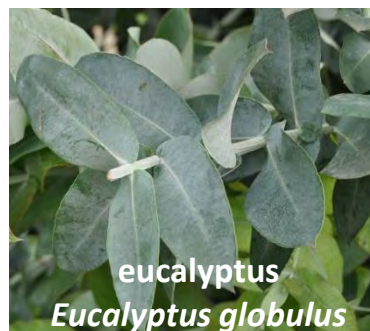
# Most important essential oils by trade volume (top 16)



orange  
*Citrus sinensis*



litsea  
*Litsea cubeba*



eucalyptus  
*Eucalyptus globulus*



lemon  
*Citrus limon*



Scotch spearmint  
*Mentha x gracilis*



Chinese cedarwood  
*Cupressus funebris*



mustard oil  
*Brassica*



clove leaf  
*Syzygium aromaticum*



lavender  
*Lavendula officinalis*



Lavandin  
*Lavendula x*



lime  
*Citrus aurantifolia*



cornmint  
*Mentha canadensis*



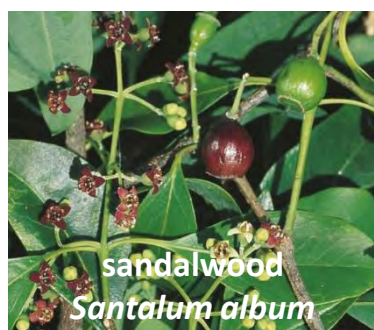
camphor  
*Cinnamomum camphora*



patchouli  
*Pogostemon cablin*



citronella  
*Cymbopogon winterianus/nardus*



sandalwood  
*Santalum album*



vetiver  
*Vetiveria zizanioides*



helichrysum  
*Helichrysum italicum*



rose oil/concrete  
*Rosa damascena*



frankincense  
*Boswellia serrata*

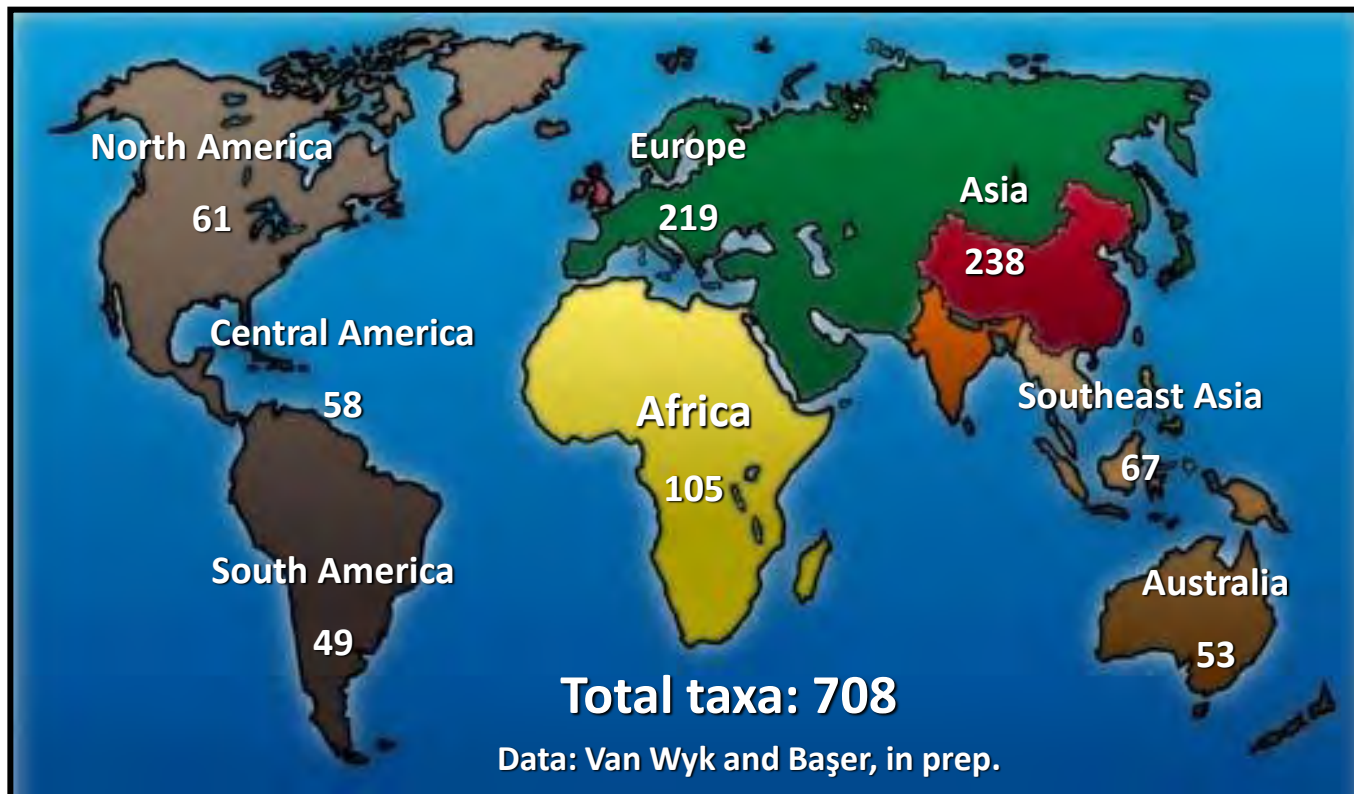
# Inventory of commercialised essential oils – 708 species, 43 from RSA

Next step - evaluate each species: Tree vs shrub vs herb? Ecological preference? Availability? Market?

No	Scientific name; family name; common name(s); trade name(s)
1	<i>Abies alba</i> L. (Pinaceae); fir tree, silver fir, white fir, silver spruce, European silver fir, white spruce (silver fir oil)
2	<i>Abies balsamea</i> (L.) Mill. (Pinaceae); balsam fir, Canadian balsam, American silver fir (Canadian fir needle oil)
3	<i>Abies concolor</i> (Gordon & Glend.) Lindl. ex Hildebr. (Pinaceae); white fir (white fir essential oil)
4	<i>Abies grandis</i> (Douglas ex D.Don) Lindl. (Pinaceae); grand fir, giant fir, lowland white fir, great silver fir essential oil)
5	<i>Abies sachalinensis</i> (F.Schmidt) Mast. var. <i>mayriana</i> Miyabe & Kudô [= <i>Abies mayriana</i> ] (Pinaceae); Sachalin fir (Japanese fir needle (oil))
6	<i>Abies sibirica</i> Ledeb. (Pinaceae); Siberian fir (Siberian fir needle oil) <i>Acacia caven</i> - see <i>Vachellia caven</i> (Molina) Seigler & Ebinger
7	<i>Acacia dealbata</i> Link (Fabaceae); silver wattle ( <b>mimosa absolute</b> )
8	<i>Acacia decurrens</i> (J.C.Wendl.) Willd. (Fabaceae); green wattle ( <b>mimosa absolute</b> )
9	<i>Achillea erba-rotta</i> All. [= <i>A. moschata</i> Wulfen] (Asteraceae); simple leaved milfoil, iva, musk yarrow oil)
10	<i>Achillea ligustica</i> All. (Asteraceae); : southern yarrow, Ligurian yarrow (Ligurian yarrow oil).
11	<i>Achillea millefolium</i> L. (Asteraceae): common yarrow, milfoil, nosebleed, thousand leaf (yarrow oil)
12	<i>Achillea tenuifolia</i> Lam. [= <i>A. santolina</i> L.] (Asteraceae)
13	<i>Acmella oleracea</i> (L.) R.K.Jansen [= <i>Spilanthes acmella</i> var. <i>oleracea</i> ]; Brazilian cress (jambu oil, jambu extract, spilanthes oil)
14	<i>Acorus calamus</i> L. var. <i>angustatus</i> Besser [= <i>Calamus aromaticus</i> Garsault]: sweet flag, calamus (calamus oil calamus root essential oil)
15	<i>Adesmia boronioides</i> Hook.f. (Asteraceae); paramela (paramela essential oil)
16	<i>Aeollanthus myrianthus</i> Baker subsp. <i>gamwelliae</i> (G.Taylor) Ryding [= <i>Aeollanthus gamwelliae</i> G.Taylor (Lamiaceae); ninde (ninde oil)
17	<i>Aetoxylon sympetalum</i> (Steenis & Domke) Airy Shaw (Thymelaeaceae); white oud, gaharu buaya, crocodile eaglewood (white oud oil)

# Global view: number of commercialised essential oil plants

Genetically rich southern hemisphere  
vs  
Genetically poor northern hemisphere

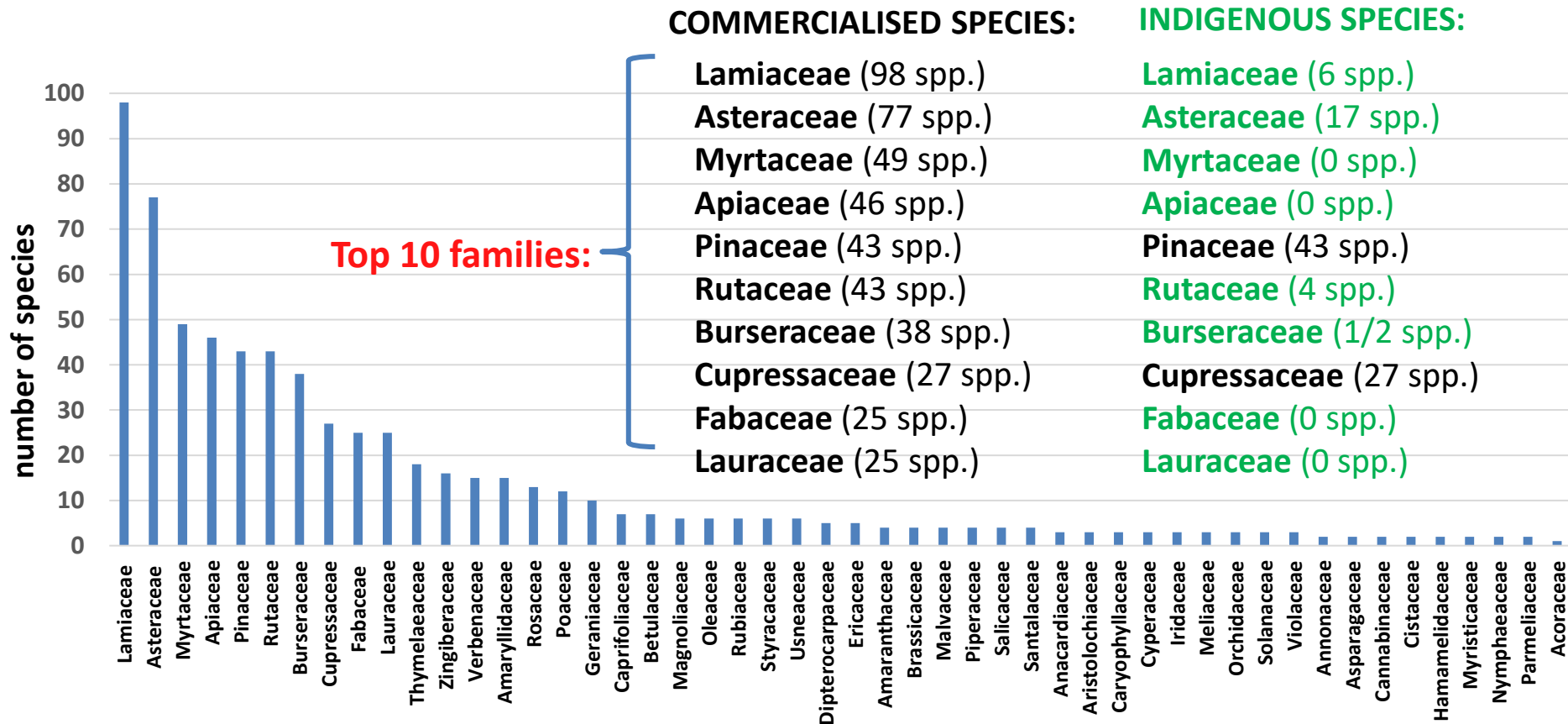


# Diversity at family level – top 50 commercial essential oil plant families

Next step is to zoom in and create reviews of selected families and species:

Habit: Tree vs shrub vs herb? Ecological preference (where will it grow well)? Is there a market?

**Priority families:** **Lamiaceae** (*Salvia dentata?*); **Asteraceae** (*Dicerotheramnus rhinocerotis* as SA frankincense? *Artemisia afra?*); **Apiaceae** (anise root, *Annesorhiza* spp.? *Foeniculum?*); **Rutaceae** (*Diosma* spp.? many candidates!, poorly studied); **Burseraceae** (38 spp.), *Commiphora* spp.? – South African myrrh?); **Fabaceae** (25 spp., 0 in South Africa, *Vachellia erioloba?* – African oud?, mimosa absolute?)



# Conclusions

- **Inventories and reviews of essential oil plants are critically needed to provide data for new innovations** (a first global inventory shows 708 commercialised species, 43 from South Africa)
- **The first option for success is to compete with existing crops in existing markets** (for those species that are ecologically suitable / already present as weeds in South Africa)
- **The second option for success is to develop new crops and new products from indigenous species** (recent research showed that many poorly known, traditionally used essential oil plants are available for evaluation – e.g., *renosterbos*, *bloublomsalie*)

