

Diversity and ecological state of aromatic plants

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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

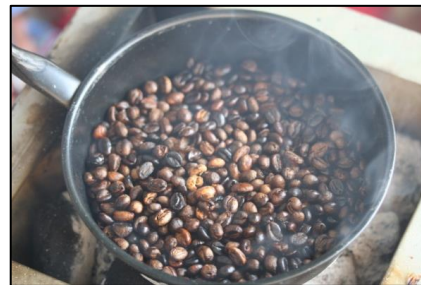
(*Commiphora myrrha*, Burseraceae)

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*)

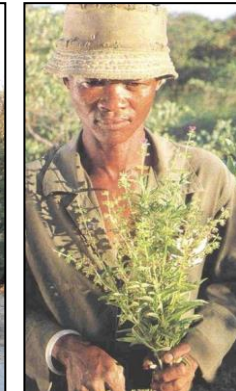
The *Sanqua* or *Sonqua* (Bushmen) are
named after aromatic plants



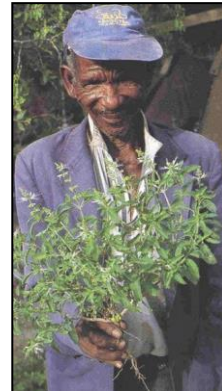
San healer women
(Central Kalahari)



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)



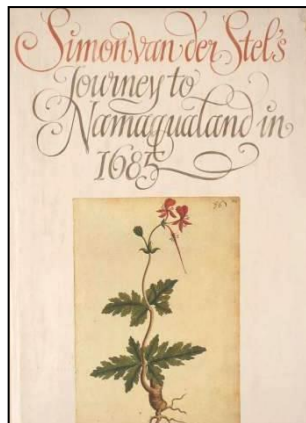
Thunberg
(1799)



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



buchu
(*Diosma acmaeophylla*)



Facsimile edition,
1979



Simon van der
Stel (1685)



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



Commelin
(1692, 1706)



*Spiraea Africana
Odorata* in
Commelin (1706)



San or Son
(*Pteronia
onobromoides*)

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Two possible options (both require detailed inventories):

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(i.e., create new products and new markets – numerous
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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?

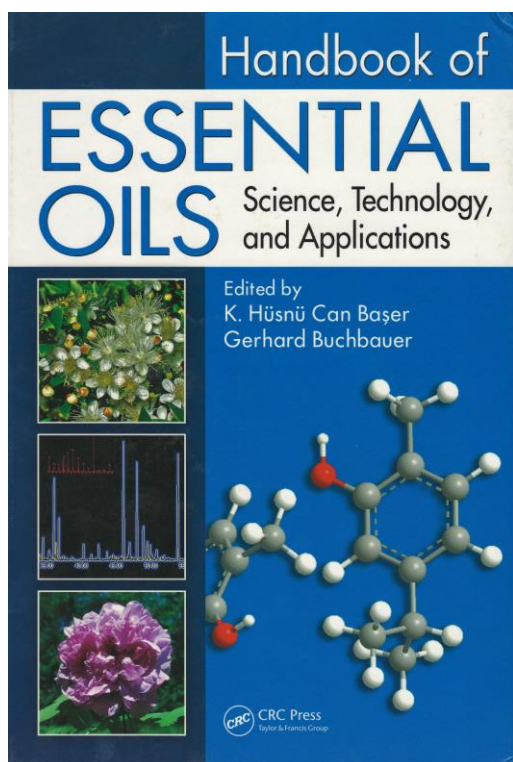
Available databases on essential oils

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

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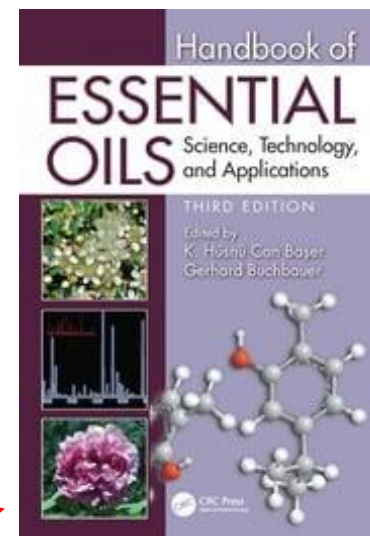


HANDBOOK OF ESSENTIAL OILS:
Science, Technology and Applications

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, S. Africa
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

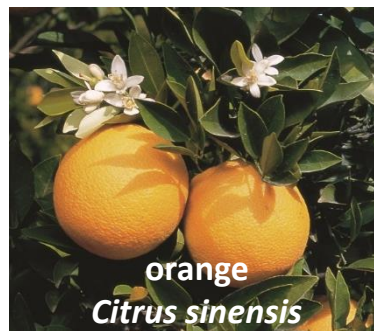
Source: Lecture by K. Hüsnu Can Başer “GLOBAL TRADE AND POTENTIAL OF ESSENTIAL OILS”

Most important essential oils in international trade (by value)

Oil	Source	Prod. (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, S. Africa
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, S. Africa
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”

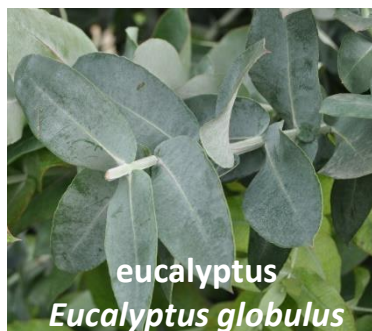
Most important essential oils by trade volume (top 16)



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

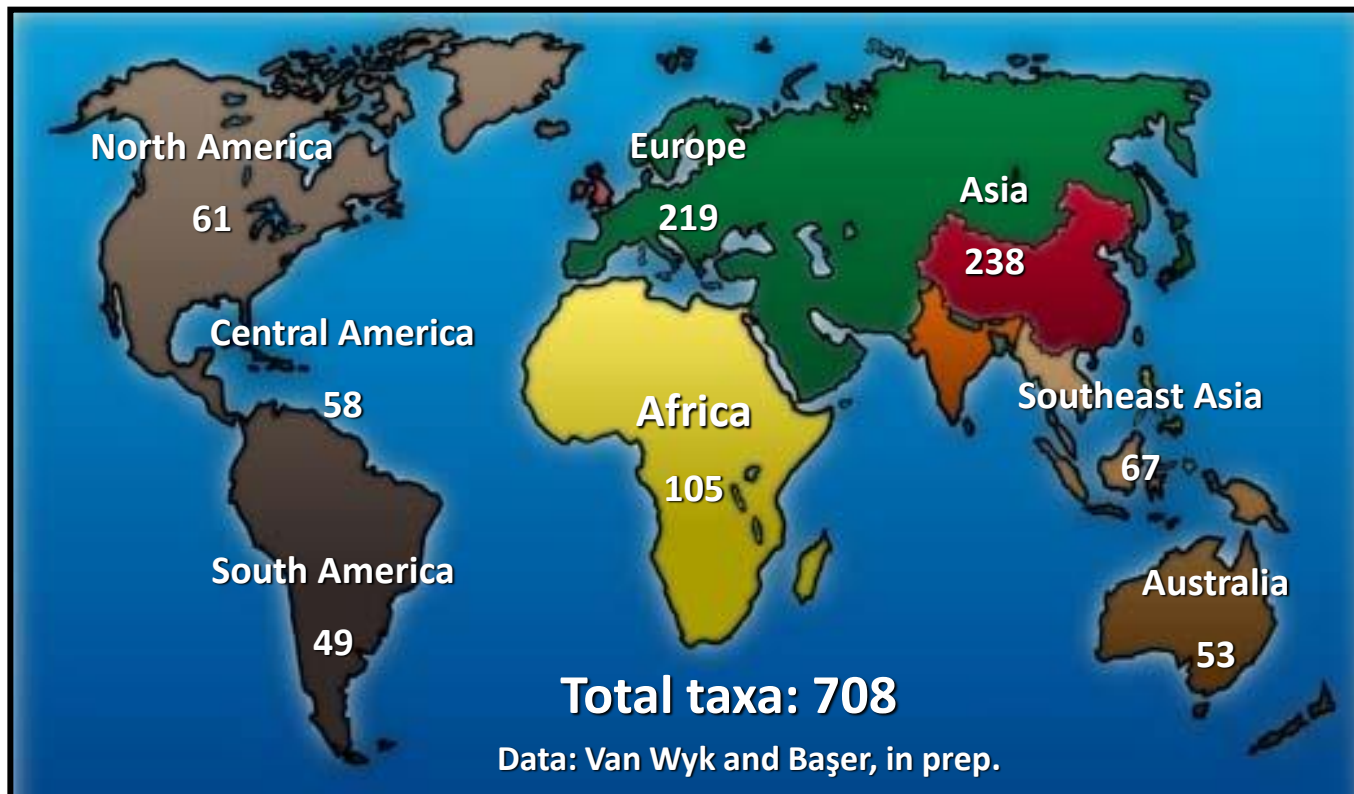
Inventory of commercialised essential oils – 708 species, 43 from RSA

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 (mimosa absolute)
8	<i>Acacia decurrens</i> (J.C.Wendl.) Willd. (Fabaceae); green wattle (mimosa absolute)
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

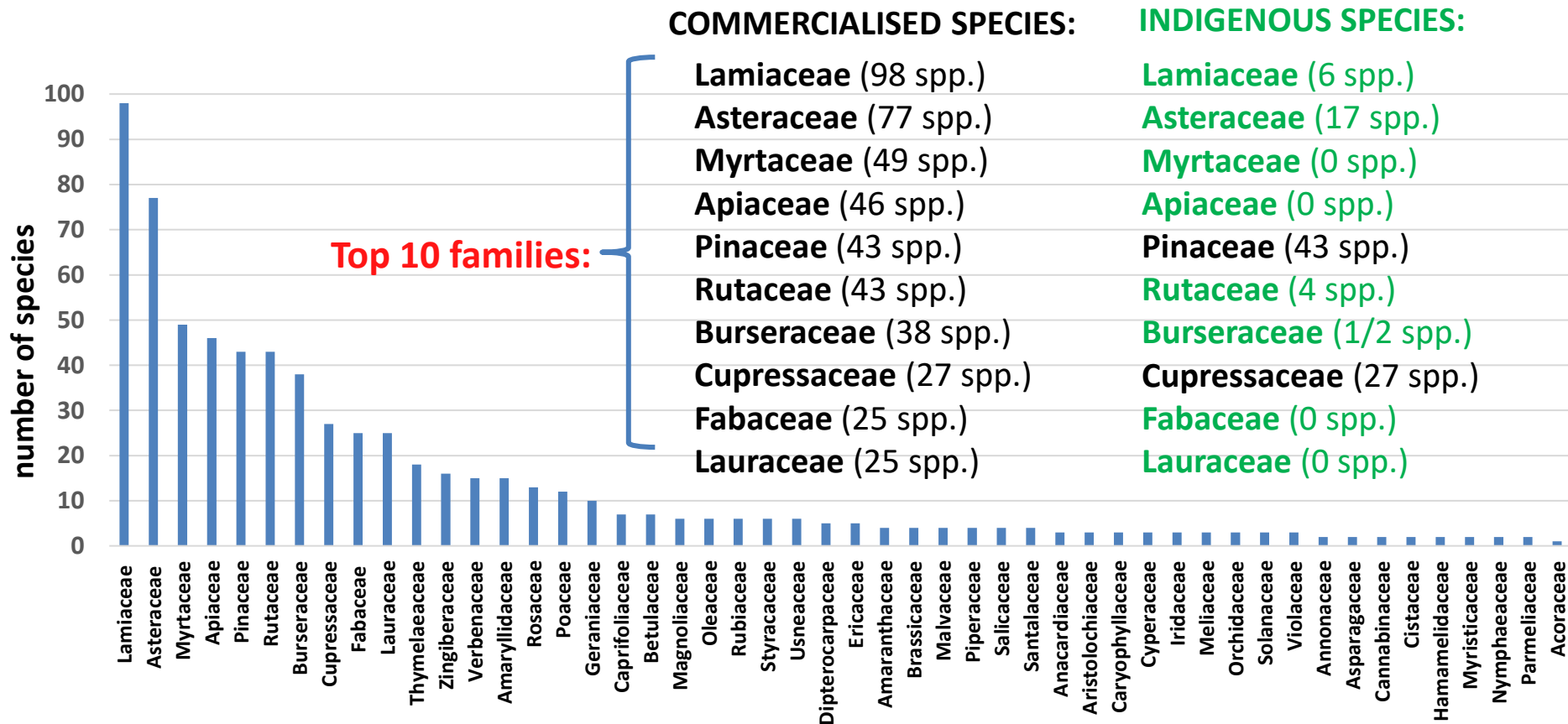


Diversity at family level – top 50 commercial essential oil plant families

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*)

