

INVASIVE ALIEN PLANTS USED IN THE TREATMENT OF HIV/AIDS-RELATED SYMPTOMS BY TRADITIONAL HEALERS OF VHEMBE MUNICIPALITY, LIMPOPO PROVINCE, SOUTH AFRICA

S.G. Mbambala, M.P. Tshisikhawe^{1*}, N.A. Masevhe

Department of Botany, School of Mathematical and Natural Sciences, University of Venda, Private bag X5050, Thohoyandou 0950, South Africa.

*Corresponding Author Email: tshisip@univen.ac.za

Article History

Received: 31, Jan. 2017

Revised Received: 05, May. 2017

Accepted: 10, May. 2017

Published Online: 01, Oct. 2017

Abstract

Background: Invasive alien plants have been known to play an important role in the lives of rural communities with regard to food security, ornamental purposes, as well as primary healthcare. The study presents the results of data collected through a survey on the use of invasive alien plants in the treatment of HIV/AIDS related symptoms.

Materials and Methods: Twenty-one traditional healers were interviewed using semi structured questionnaires. Parameters recorded during the interviews were local names, symptoms treated, plant parts used, life form and availability estimates of the plant species.

Results: A total of 38 invasive alien plant species belonging to 23 families were recorded to be used in the treatment of HIV/AIDS related symptoms. The largest proportion of recorded invasive alien plants belonged to the family Asteraceae with 16%. Roots were the most frequently used parts constituting 35% followed closely by leaves with 34%. Wounds were the main symptoms treated with a proportion of 56% followed by gonorrhoea (20%).

Conclusion: From the study, invasive alien plant species played a vital role in traditional primary healthcare. Despite their medicinal potential, it is recommended that traditional healers and community members be educated on the impact of invasive alien plants on biodiversity.

Key words: Invasive alien plants, HIV/AIDS, Traditional healers, Vhembe District Municipality.

List of abbreviations: AIDS - Acquired Immune Deficiency Syndrome, HIV - Human Immunodeficiency Virus, CARA - Conservation of Agricultural Resource Act, IAS - Invasive Alien Species.

Introduction

Medicinal plants and herbal medicinal products utilization worldwide has grown dramatically in the last few decades (Chinyama, 2009). The use of medicinal plants in herbal medicine is a practice that is very old and continues to be prevalent all over the world. The dependence on plants as a source of medicine in developing countries is still common with traditional medicine playing a major role in health care delivery (Chinyama, 2009).

The problems posed by invasive alien species (IAS) that are also utilized in traditional medicine in Africa and the rest of the world are, therefore, not new. Societies have suffered from the impacts of IAS as long as humans have intentionally and unintentionally moved organisms around the world (Macdonald et al., 2003).

Semenya et al. (2012a) noted 117 alien plants as well-established, major invaders that are widely distributed in South Africa. These authors suggested that widespread alien invaders should be managed at national scale. Southern Africa is severely affected by alien invasions, and has one of the biggest problems with invasions than any other area in the world (Macdonald et al., 2003).

Today in South Africa, at least 161 exotics species have been declared as the worst invaders and are listed under the Conservation of Agricultural Resources Act (1983) (CARA) No. 43 of 1983. The current study, therefore aimed at documenting invasive alien plants used in treatment of HIV/AIDS related symptoms by traditional healers of Vhembe District Municipality, Limpopo Province, South Africa.

The study was conducted in the Vhembe District Municipality of the Limpopo Province, South Africa. The Limpopo Province falls within the coordinates 22°56'S 30°28'E. The total population of Vhembe District is about 1.2 million. The population of Black Africans is 98.48%, Whites 1.14%, Indians/Asians 0.24%, and 0.14%. The surface area of Vhembe District Municipality is 25,597 square kilometers (Census, 2011).

Vhembe District Municipality is located in the northern part of the Limpopo province (Fig. 1). It shares borders with Zimbabwe and Botswana in the north-west and Mozambique in the south-east through the Kruger National Park. The Limpopo River valley forms the border between the district and its international neighbours. It is comprised of four local municipalities: Musina, Mutale, Thulamela and Makhado, and the main towns are Thohoyandou, Musina and Makhado. (Local Government Handbook Survey, 2012).



Figure 1: Map of Limpopo Province showing Vhembe District Municipality, South Africa

Materials and Methods

Data was collected through the use of semi-structured questionnaire. Prior informed consent was sought from the traditional healers who participated in the study. The survey was done through interviews with traditional healers, who knew more about medicinal plants that treat HIV/AIDS related symptoms. Informants were interviewed of their medicinal knowledge on invasive alien plants found in Limpopo Province as well as HIV/AIDS related symptoms as identified by traditional healers. The interviews with informants were conducted in their local languages.

A total of 21 traditional healers comprised of 14 females and 7 males were interviewed (Table 1). The greater participation of females in the interviews showed that they had more knowledge with regard to the treatment and management of HIV/AIDS related symptoms.

Table 1: Age and sex characteristics of traditional healers interviewed

| Sex | Age (years) | | | Total |
|--------|-------------|-------|-------|-------|
| | 21-40 | 41-60 | 61-80 | |
| Female | 0 | 6 | 8 | 14 |
| Male | 0 | 4 | 3 | 7 |

Data associated with the 38 exotics species was collected and stored in Microsoft Excel 2010 programme. Descriptive statistics elements like percentages and frequencies, have been analysed to reveal statistical patterns.

Data on plant species, families, symptoms treated, plant part(s) used, availability and frequency were also recorded and analysed.

Results and Discussion

The study recorded 38 plant species (24 families) (Table 2), which were used by traditional healers in the treatment of various symptoms related to HIV/AIDS. A list of plant species with family names, botanical names, vernacular names, symptoms treated, plant part(s) used, availability and the frequency of use were presented in Table 2.

Table 2: Invasive alien medicinal plants used by Traditional healers to treat HIV/AIDS related symptoms in Vhembe district Municipality.

| FAMILY | SCIENTIFIC NAME | COMMON NAME | SYMPTOMS TREATED | PLANT PART(S) USED | AVAILABILITY | FREQUENCY USE | LIFE FORM |
|----------------|---|---|------------------------------|--------------------|--------------|---------------|-----------|
| Agavaceae | <i>Agave sisalana</i> Perrine. | Sisal (E), Tshikwenga (V) | Gonorrhoea, wounds, headache | R, W | M | 11 | Shrub |
| Apocynaceae | <i>Catharanthus roseus</i> (L.) G.Don | Madagascar periwinkle (E), Muluvha (V) | Gonorrhoea | R, L | M | 6 | Herb |
| Apocynaceae | <i>Nerium oleander</i> L. | Oleander (E), Mukonadipfa (V) | Wounds | L, B | M | 6 | Shrub |
| Asclepiadaceae | <i>Araujia sericifera</i> Brot. | Moth catcher (E), | Wounds, headache | R | M | 6 | Climber |
| Asteraceae | <i>Ageratum conyzoides</i> L. | Invading ageratum, Tshidzingambule (V) | Wounds | L | M | 7 | Herb |
| Asteraceae | <i>Ageratum houstonianum</i> Mill. | Mexican ageratum (E), Munyelenga (V) | Gonorrhoea | R | M | 3 | Herb |
| Asteraceae | <i>Bidens pilosa</i> L. | Blackjack (E), Mushidzhi (V) | Wounds | W, L, R | M | 9 | Herb |
| Asteraceae | <i>Taraxacum officinale</i> F.H. Wigg | Dandelion (E), Tshii mangamulenzhe (V) | - | - | - | 0 | Herb |
| Asteraceae | <i>Tithonia rotundifolia</i> (Mill.) S.F. Blake | Red Sunflower (E), Tshisevhesevhe (V) | Wounds | W | M | 2 | Shrub |
| Asteraceae | <i>Xanthium strumarium</i> L. | Large cocklebur (E), Muvayanguluvhe (V) | Wounds | L, R | M | 6 | Herb |
| Bignoniaceae | <i>Jacaranda mimosifolia</i> D.Don | Jacaranda (E) Mudzhakarannya (V) | Fever, gonorrhoea | L, B | M | 8 | Tree |
| Bignoniaceae | <i>Tecoma stans</i> (L.) Juss. ex Kunth | Yellow bells (E), | - | - | - | 0 | Shrub |
| Cactaceae | <i>Opuntia ficus-indica</i> (L.) Mill. | Sweet prickly pear (E) Mudoro (V) | Mouth sores, wounds | L, R, W | M | 9 | Shrub |
| Cannaceae | <i>Canna indica</i> L. | Indian shot (E), Mpesela (V) | Wounds | R, L | M | 2 | Herb |
| Casuarinaceae | <i>Casuarina cunninghamiana</i> Miq. | Beefwood (E) Musanana (V) | Gonorrhoea | F | M | 3 | Tree |
| Crassulaceae | <i>Bryophyllum delagoense</i> (Eckl. & Zeyh.) Druce | Chandelier-plan (E), Mutungupfa (V) | Wounds, gonorrhoea | L | M | 5 | Shrub |
| Euphorbiaceae | <i>Ricinus communis</i> L. | Castor-oil plant (E) Mupfure (V) | wounds, gonorrhoea | W, R, F | M | 11 | Shrub |
| Fabaceae | <i>Albizia lebeck</i> (L.) Benth. | Lebeck tree (E), Mupfumbadzi (V) | Wounds | L, S | M | 8 | Tree |
| Fabaceae | <i>Caesalpinia decapetala</i> (Roth) Alston | Mauritius thorn (E) Luanakha (V) | Wounds, coughing | L, R, B | M | 6 | Tree |

| | | | | | | | |
|----------------|---|---|--------------------------------|---------|---|----|---------|
| Fabaceae | <i>Senna didymobotrya</i> (Fresen.) Irwin & Barneby | Peanut butter cassia (E), | Wounds | L | M | 2 | Tree |
| Hypericaceae | <i>Hypericum perforatum</i> L. | St. John's wort (E), | Wounds, coughing | L, B | M | 4 | Herb |
| Lamiaceae | <i>Mentha longifolia</i> (L.) Huds. | Horse mint (E), | Gonorrhoea | R | M | 3 | Herb |
| Meliaceae | <i>Melia azedarach</i> L. | Chinaberry and Umbrella tree (E) Muserenga (V) | Wounds, gonorrhoea | B, W | M | 12 | Tree |
| Myrtaceae | <i>Eucalyptus paniculata</i> Sm. | Mubomo (V) | Flu-like fever, wounds | L, R | M | 11 | Tree |
| Myrtaceae | <i>Psidium guajava</i> L. | Guava (E) Mugwavha (V) | Wounds | R, L, B | M | 9 | Tree |
| Papaveraceae | <i>Argemone ochroleuca</i> Sweet. | White-flowered Mexican poppy (E) Zavhazavha (V) | Gonorrhoea, wounds, sore teeth | W, L, R | M | 11 | Herb |
| Passifloraceae | <i>Passiflora suberosa</i> L. | Devil's pumpkin (E), | - | - | - | 0 | Climber |
| Passifloraceae | <i>Passiflora subpeltata</i> Ortega | Granadina (E) Mugurunandela (V) | Wounds, helps in giving birth | R | M | 8 | Climber |
| Pinaceae | <i>Pinus patula</i> Schiede ex Schltdl. & Cham. | Mexican weeping pine (E) Mupaini (V) | Wounds | R | M | 1 | Tree |
| Poaceae | <i>Phragmites mauritianus</i> Kunth. | Giant reed (E), Lutanga (V) | Wounds | R | M | 6 | Herb |
| Poaceae | <i>Cortaderia jubata</i> (Lem.) Stapf | Purple pampas grass (E), Dumbulasimbe (V) | Wounds | R | M | 3 | Herb |
| Rosaceae | <i>Rubus cuneifolius</i> Pursh | Blackberry/ American bramble(E) Munambala (V) | Wounds | L | M | 2 | Shrub |
| Salicaceae | <i>Salix babylonica</i> L. | Babylon willow (E) Munengeledi (V) | Wounds | B, L | M | 3 | Tree |
| Solanaceae | <i>Datura stramonium</i> L. | Downy thorn apple (E), Tshikhavhakhavha (V) | Wounds | R, L | M | 8 | Herb |
| Solanaceae | <i>Solanum mauritianum</i> Scop. | Bugweed (E) Litutulwa (V) | Wounds | R, W, F | M | 10 | Herb |
| Solanaceae | <i>Solanum nigrum</i> L. | Black Berry (E) Muxe (V) | Wounds | R, L | M | 8 | Herb |
| Verbenaceae | <i>Lantana camara</i> L. | Lantana (E) Tshidzimbambule (V) | Sore eyes, coughing | L | M | 5 | Shrub |
| Zingiberaceae | <i>Hedychium flavescens</i> Carey ex Roscoe | Yellow ginger (E), | Wounds, fever | R | L | 2 | Herb |

*R- roots, L- leaves, S- seeds, B- Barks, F- Fruits, W- whole plant, M- moderate, L- Low, Dash – lack of knowledge, E- English, V- Tshivenda.

Amongst the 38 plants recorded, the most frequently used plants were *Solanum mauritianum* Scop., *Ricinus communis* L., *Melia azedarach* L., *Eucalyptus paniculata* Sm., *Argemone ochroleuca* Sweet., and *Agave sisalana* Perrine.

Table 3: The scientific name, origin, CARA listed species and mode of dispersal of alien invasive medicinal plants (Invasive Species South Africa database).

| SCIENTIFIC NAME | Suspected Origin | CARA | Mode of Dispersal |
|---|--|------|--|
| <i>Agave sisalana</i> Perrine. | Mexico | 2 | Seeds and suckering |
| <i>Ageratum conyzoides</i> L. | South America | 1 | Seed dispersal |
| <i>Ageratum houstonianum</i> Mill. | Mexico | 1 | Seed dispersal |
| <i>Albizia lebbek</i> (L.) Benth. | Asia | 1 | Seed dispersal |
| <i>Araujia sericifera</i> Brot. | South America | 1 | Seed dispersal |
| <i>Argemone ochroleuca</i> Sweet. | Mexico | - | Seed dispersal |
| <i>Phragmites mauritianus</i> Kunth. | Mediterranean | 1 | Horizontally from rootstocks |
| <i>Bidens pilosa</i> L. | Asia | - | Seed dispersal by zoochory, as are transported by animals |
| <i>Bryophyllum delagoense</i> (Eckl. & Zeyh.) Druce | Madagascar | 1 | Seed dispersal |
| <i>Caesalpinia decapetala</i> (Roth) Alston | Asia | 1 | Seeds are spread by water and animals |
| <i>Catharanthus roseus</i> (L.) G.Don | Madagascar | 1 | Invades riverbanks, waste places in dry savanna and also plantations |
| <i>Canna indica</i> L. | Caribbean and Tropica Asia | 1 | Seed dispersal and underground rhizome |
| <i>Casuarina cunninghamiana</i> Miq. | Australia | 2 | Spread by cones to the surrounding landscape |
| <i>Cortaderia jubata</i> (Lem.) Stapf | West tropical South America | 1 | Seed dispersal |
| <i>Datura stramonium</i> L. | Tropical America | 1 | Seed dispersal |
| <i>Eucalyptus paniculata</i> Sm. | New South Wale, Australia | - | - |
| <i>Hedychium flavescens</i> Carey ex Roscoe | Himalayas | - | - |
| <i>Hypericum perforatum</i> L. | Europe | 1 | Seed dispersal and underground creeping stems |
| <i>Jacaranda mimosifolia</i> D.Don | South America | 3 | Seed dispersal |
| <i>Lantana camara</i> L. | South America | 1 | Seed dispersal |
| <i>Melia azedarach</i> L. | Asia | 3 | Fruits are spread by birds, water and human activities |
| <i>Mentha longifolia</i> (L.) Huds. | Europe, Western and Central Asia | - | - |
| <i>Nerium oleander</i> L. | Mediterranean | 1 | Seed dispersal |
| <i>Opuntia ficus-indica</i> (L.) Mill. | Central America (Mexico) | 1 | Seed dispersal by animals |
| <i>Pinus patula</i> Schiede ex Schltdl. & Cham. | Eastern Mexico | - | - |
| <i>Passiflora suberosa</i> L. | South America | 1 | Seed dispersal by birds and other animals |
| <i>Passiflora subpeltata</i> Ortega | Central and South America | 1 | Birds and animals that feed on the fruits tend to spread the seeds |
| <i>Psidium guajava</i> L. | Tropical region of central and South America | 2 | Seed dispersal |
| <i>Ricinus communis</i> L. | Tropical Africa | 2 | Seed dispersal |
| <i>Rubus cuneifolius</i> Pursh | North America | 1 | Seed dispersal |

| | | | |
|--|---|---|----------------|
| <i>Salix babylonica</i> L. | Northern China | - | - |
| <i>Senna didymobotrya</i> (Fresen.) Irwin & Barneby | Tropical Africa | 1 | Seed dispersal |
| <i>Solanum mauritianum</i> Scop. | South America | 1 | Seed dispersal |
| <i>Solanum nigrum</i> L. | North-western Africa | - | - |
| <i>Taraxacum officinale</i> F.H. Wigg | Europe and Asia | - | - |
| <i>Tecoma stans</i> (L.) Juss. ex Kunth | Mexico and Texas | 1 | Seed dispersal |
| <i>Tithonia rotundifolia</i> (Mill.) S.F. Blake | Florida, Louisiana, Mexico, Central America and West Indie | - | - |
| <i>Xanthium strumarium</i> L. | South America | 1 | Seed dispersal |

The study showed that most of the alien invasive plants used by traditional healers originated from South America, followed by Asia (such as *Melia azedarach* L) then Mexico (such as *Agave sisalana* Perrine), respectively.

Seventy four percent (n=28) of the species recorded in this study is listed under Regulation 15 of the Convention of Agricultural Resources Act 43 of 1983, known as CARA (Table 3). Of these, 79% (n=22) are listed under Category 1, 14% (n=4) under category 2 and 7% (n=2) under category 3 (CARA, 1983).

Family category of alien invasive medicinal plants

The largest proportion of medicinal plants documented belonged to the family Asteraceae (16%), followed by Fabaceae and Solanaceae both with 8%, Poaceae, Apocynaceae, Myrtaceae, Bignoniaceae and Passifloraceae with 5% each, while other families were represented by 3% each.

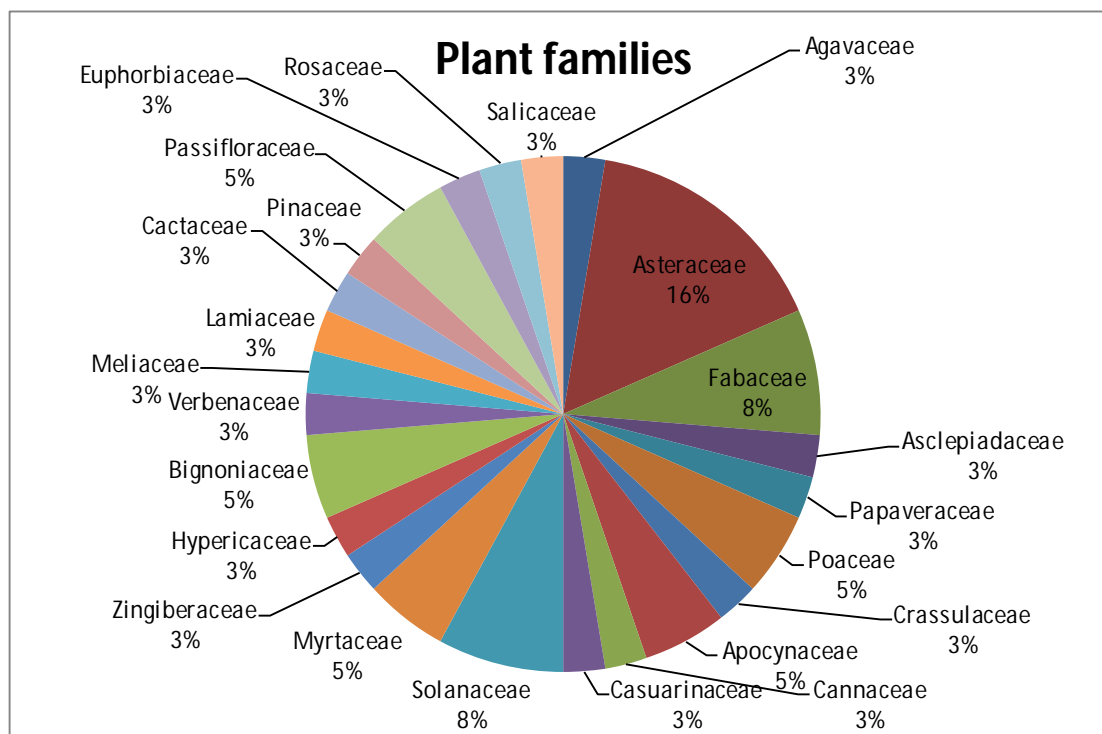


Figure 2: Family proportions of invasive alien medicinal plants used in the treatment of HIV/AIDS related symptoms in Vhembe District Municipality.

The family Asteraceae was also reported as the most common family in a study conducted in Limpopo Province by Semenya et al., (2013), with the highest proportion of 9%. Lamorde et al. (2010), also reported the family Asteraceae as having the highest proportion (14%) of invasive alien medicinal plants used to treat HIV/AIDS related symptoms in Uganda.

Growth forms of plants used to treat HIV/AIDS related symptoms

As shown in Figure 3 the study found that the life forms of invasive alien medicinal plants revealed that herbs constituted the largest number of proportion (42%), followed by trees (26%), shrubs (24%) and climbers (8%). Results of this study correlated strongly with those of Khan et al. (2011), who reported that life forms of invasive alien medicinal plants used by the local inhabitants of Bangladesh for traditional health, constituted the largest number or proportion of growth forms with herbs (16 species), followed by shrubs (11 species). The results were also in consistent with those of Njoroge et al. (2004), who reported the dominance of herbs (65%), followed by shrubs (32%) in their study of medicinal weed species in Central Kenya.

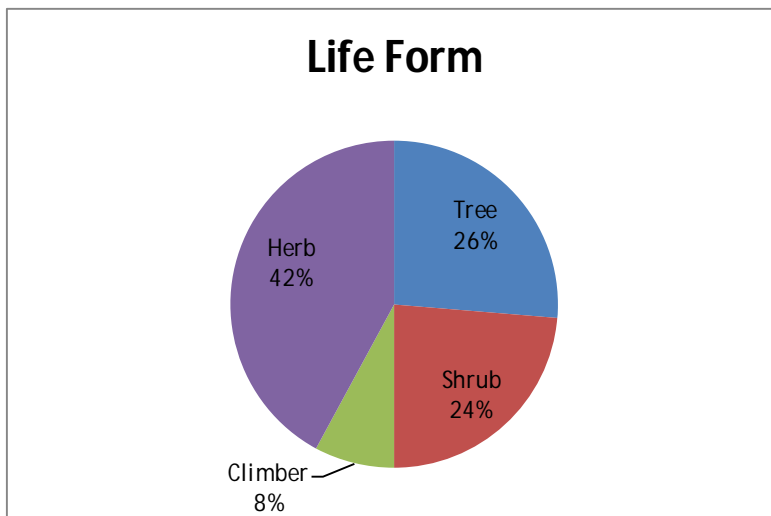


Figure 3: Growth forms of plants used to treat HIV/AIDS related symptoms.

Plant parts used by traditional healers to treat HIV/AIDS related symptoms

Figure 4, showed that the roots (35%) contributed the highest percentage in terms of plants parts used followed by leaves (34%), barks (11%), and then the whole plant (13%). Fruits and seeds had the least percentages of 5% and 2% respectively. The dominance of roots was also observed in a survey conducted by Semanya et al. (2012b) on the medicinal use of exotic species by Bapedi people of Limpopo Province, South Africa.

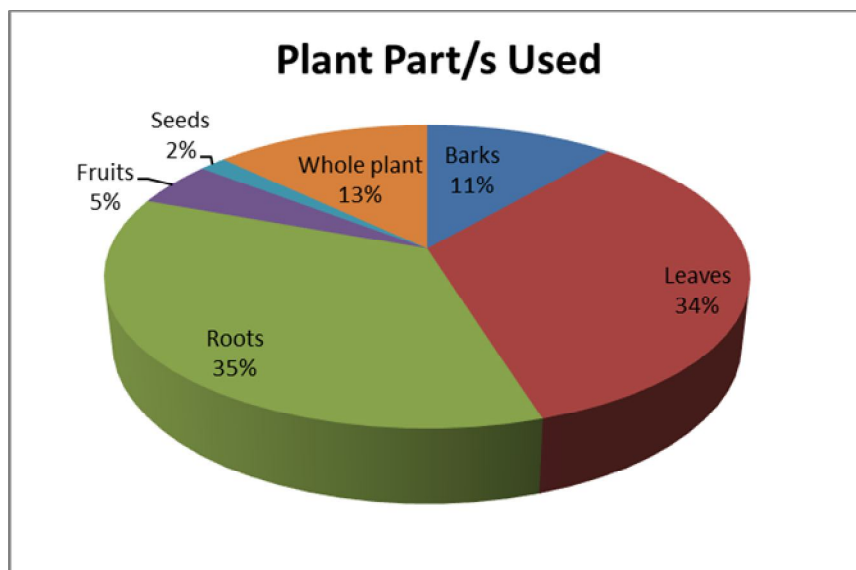


Figure 4: Plant parts harvested by traditional healers to treat HIV/AIDS related symptoms.

HIV/AIDS related symptoms treated by traditional healers

Figure 5 showed that wounds (35%) contributed the highest percentage in terms of symptoms treated followed by gonorrhoea (20%), fever (6%), cough (6%), headache (4%) and other symptoms represented by 2% each. Similar

trends showing the dominance of wounds treatment were reported by Khan *et al.* (2011), in their study on usage of invasive alien medicinal plants of Bangladesh.

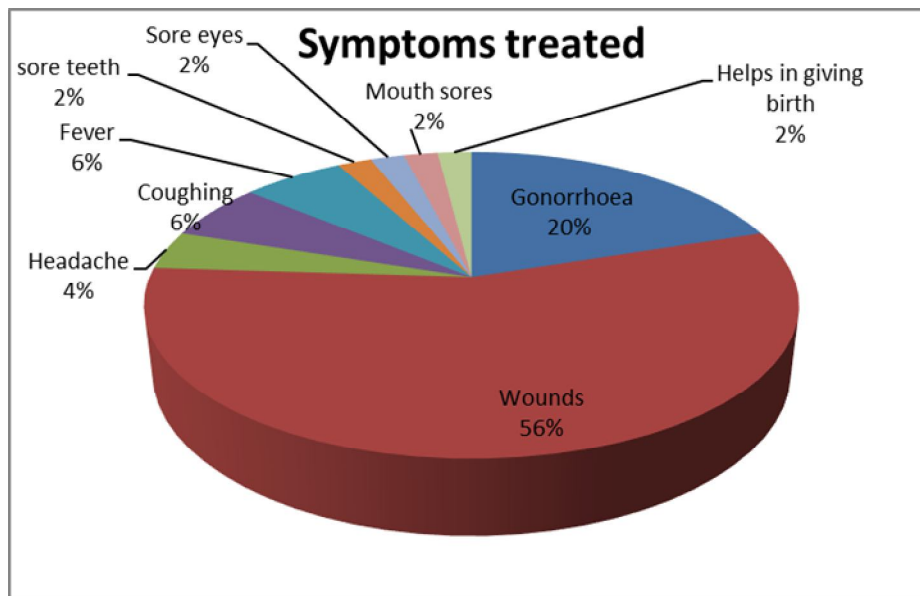


Figure 5: HIV/AIDS related symptoms treated by traditional healers.

Dispersal mode of alien invasive medicinal plants

Seed dispersal by wind (58%) is the highest mode of dispersal followed animals (17%), water (6%), while other dispersal modes were represented by 3% each. The same trend was also reported by Anačkov *et al.* (2013) in the work done on the Pannonian plants. Dispersal by wind and autochory recorded in alien species, definitively contribute to range expansion and habitat invasion. Seeds are most commonly dispersed by zoochory (animal activity).

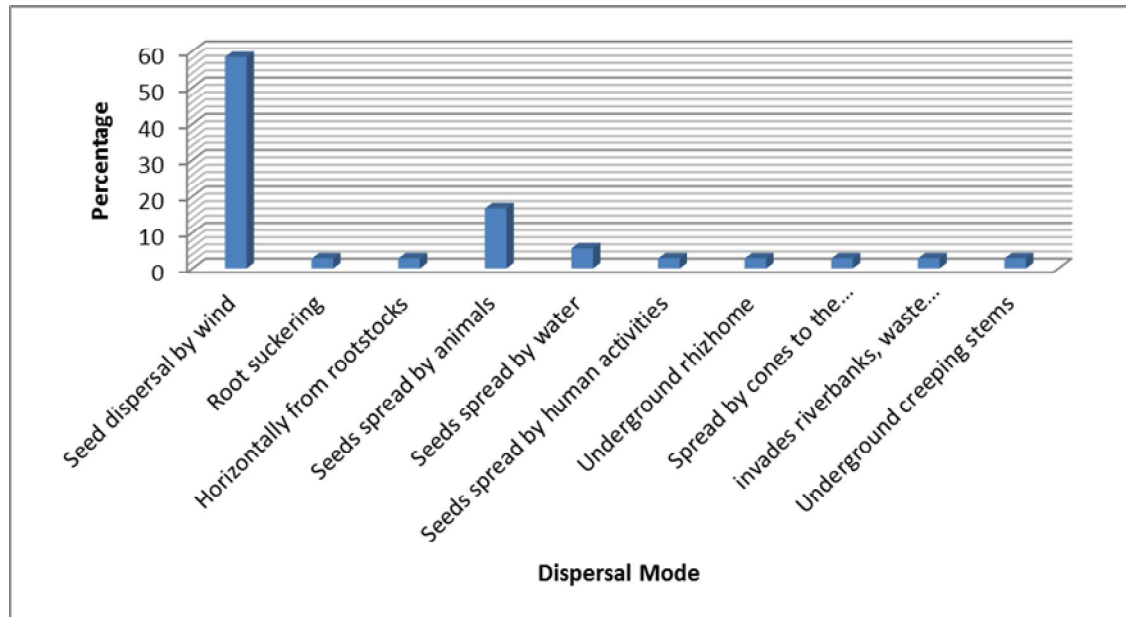


Figure 6: Dispersal mode of alien invasive medicinal plants

Conclusion and Recommendations

This study has disclosed that medicinal invasive alien plant species played a vital role in the traditional primary healthcare of local people of Vhembe District Municipality, and that the use of traditional medicine is still an important part of their socio-cultural life.

The study revealed that traditional healers from Vhembe District Municipality, who are mostly women, possessed a good knowledge of HIV/AIDS related symptoms. The practise is most influenced by local people's preference to use traditional medicine over allopathic medicine in the treatment of HIV/AIDS related symptoms because it is easily accessible. The study also confirmed that males are more reluctant in sharing their knowledge as compared to females (Masevhe et al., 2015, York et al., 2011).

The fact that traditional healers mostly preferred the use of roots in their treatment is a good thing because such harvesting techniques may ultimately assist in the management of invasive alien plants. It is recommended that traditional healers and community members should be encouraged to utilize invasive alien plants so that pressure is alleviated from indigenous plant species.

Acknowledgements

The authors are grateful to the traditional healers of Vhembe District Municipality, Limpopo province, South Africa. The NRF Biodiversity SARChI chair is acknowledge for provision of funding. This study was approved by the University of Venda's Research and Publication Committee SMN/15/BOT/02.

Declaration: Authors declare that this research presents no conflict of interests.

References

1. Anačkov, G.T., Rat, M.M., Radak, B.D., Igić, R.S., Vukov, D.M., Ručando, M.M., Krstivojević, M.M., Radulović, S.B., Cvijanović, D.L., Milić, D.M., Panjković, B.I., Szabados, K.I, Perić, R.D., Kiš, A.M., Stojšić, V.R. and Boža, P.P. (2013). Alien invasive neophytes of the South-Eastern part of the Pannonian Plain. *Cent. Eur. J. Biol.*, 8: 1032-1047.
2. Census. (2011). Statistics South Africa. Retrieved 6 November 2012. http://www.statssa.gov.za/?page_id=3839
3. Chinyama, R.F. (2009). Biological activities of medicinal plants traditionally used to treat septicaemia in the Eastern Cape, South Africa. MSc thesis, Nelson Mandela Metropolitan University.
4. Conservation of Agricultural Resources Act. (1983). Department of Agriculture, (Act no. 43 of 1983). South Africa, Pretoria.
5. Invasive Species South Africa database. <http://www.invasives.org.za/#>
6. Khan, M.A.S.A., Sultana, F., Rahman, M.H., Roy, B. and Anik, S.I. (2011). Status and ethno-medicinal usage of invasive plants in traditional health care practices: A case study from North Eastern Bangladesh. *J. For. Res.*, 22: 649–658
7. Lamorde, M., Tabutic, J.R.S., Obua, C., Kukunda-Byobona, C., Lanyero, H., Byakika-Kibwika, P., Bbosa, G.S, Lubega, A., Ogwal-Okeng, J., Ryan, M., Waako, P.J, and Concepta. M.C. (2010). Medicinal plants used by traditional medicine practitioners for the treatment of HIV/AIDS and related conditions in Uganda. *J. Ethnopharmacol.*, 130: 43–53.
8. Local Government Handbook Survey. (2012). A complete guide to municipalities in South Africa. 2nd edition. Yes Media Publishers. Cape Town, South Africa.
9. Macdonald, I.A.W., Reaser, J.K., Bright, C., Neville, L.E., Howard, G.W., Murphy, S.T. and Preston, G. (2003). Invasive alien species in southern Africa: national reports and directory of resources. Global Invasive Species Programme. Cape Town, South Africa.
10. Masevhe, N.A., McGaw, L.J, Eloff, J.N. (2015). The traditional use of plants to manage candidiasis and related infections in Venda, South Africa. *J. Ethnopharmacol.*, 168: 364 – 372.
11. Njoroge, N.G., Bussmann, W.R., Gemmil, B., Newton, L.E., and Ngumi, V.W. (2004). Utilisation of weed species as source of traditional medicines in central Kenya. *Lyonia*, 7: 72-87.
12. Semanya, S.S., Tshisikhawe, M.P. and Potgieter, M.T. (2012a). Invasive alien plant species: A case study of their use in the Thulamela Local Municipality, Limpopo Province, South Africa. *Sci. Res. Essays*, 7(27): 2363-2369.
13. Semanya, S., Potgieter, M., Tshisikhawe, M., Shava, S. and Maroyi, A. (2012b). Medicinal utilization of exotic plants by Bapedi traditional healers to treat human ailments in Limpopo province, South Africa. *J. Ethnopharmacol.*, 144: 646–655.
14. Semanya, S.S., Potgieter, M.J. and Erasmus, L.J.C. (2013). Bapedi phytomedicine and their use in the treatment of sexually transmitted infections in Limpopo Province, South Africa. *Afr. J. Pharm. Pharmacol.*, 7(6): 250-262.
15. York, T., De Wet, H. and Van Vuuren, S.F. (2011). Plants used for treating respiratory infections in rural Maputaland, KwaZulu–Natal, South Africa. *J. Ethnopharmacol.*, 135: 696–710.